Compressed Air Magazine

OCTOBER 1961

IN THIS ISSUE:
- SINKING MISSILE SILOS
- SEALING DOORWAYS
- FORGING WITH AIR
- DESALTING WATER
- MAINTAINING ROCK DRILLS

COMPRESSED AIR MAGAZINE
PHILLIPSBURG, N. J.

BULK RATE
U.S. POSTAGE
PAID
EASTON, PA.
Permit No. 7

Form 3547 requested

UNIVERSITY MICROFILMS, INC.
313 NORTH FIRST STREET
ANN ARBOR, MICHIGAN

You Can Put This Line Together With a Hammer

When you need piping for air, water, dredging, or ventilating service, the combination of NAYLOR Spiralweld pipe and Wedgelock couplings can save you time, trouble and money.

Here is a line with the strength and safety to handle all of these services and you can put it together with a hammer. The pipe is light in weight, so you can transport and handle it easily. Connections are simple and fast, too. The Wedgelock coupling is designed to join grooved-end or shoulder-end pipe quickly—even with only one side of the pipe exposed. No special tools are required since a hammer is all you need to seat or unseat the wedge.

Bulletin No. 59 will give you the details of this time, work and money-saving combination. Write for a copy today.

NAYLOR offers Wedgelock couplings for both low-pressure and heavy-duty service. This simplified coupling makes a positive connection securely anchored in standard weight grooved ends.

NAYLOR PIPE *Company*

1245 East 92nd Street, Chicago 19, Illinois

Eastern U. S. and Foreign Sales Office: 60 East 42nd Street, New York 17, N. Y.

Volume 66 Number 10

October 1961

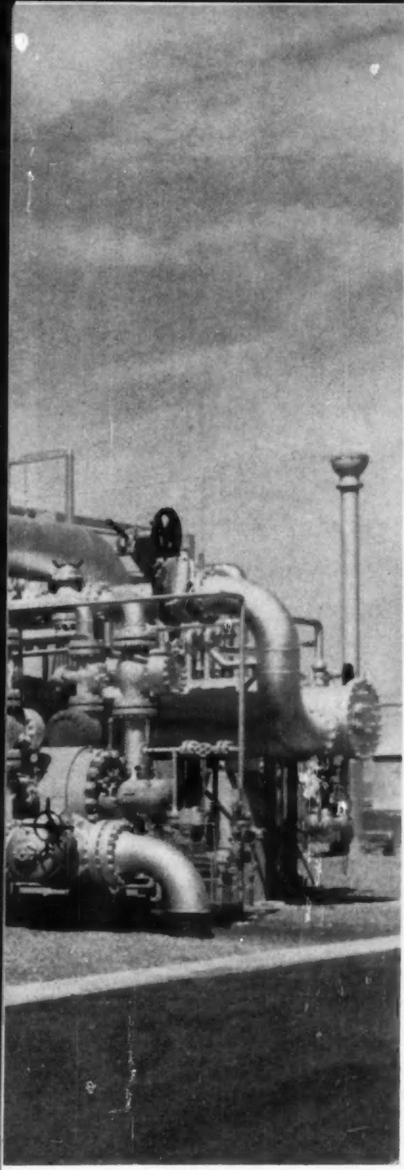
Compressed Air MAGAZINE

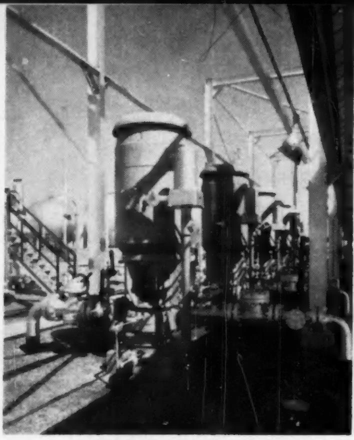
BPA Editorial, advertising and publication offices: 942 Memorial Parkway, Phillipsburg, New Jersey. Annual subscription, United States and possessions, $5: foreign, $7; single copies, domestic $0.50, foreign, $0.70. Compressed Air Magazine is indexed in Industrial Arts Index and in Engineering Index. Microfilm volumes (1940 to date) are available from University Microfilms, Inc. Published monthly by Compressed Air Magazine Company: A. W. Loomis, President; L. C. Hopton, Vice President; C. H. Biers, Secretary-Treasurer.

on the cover

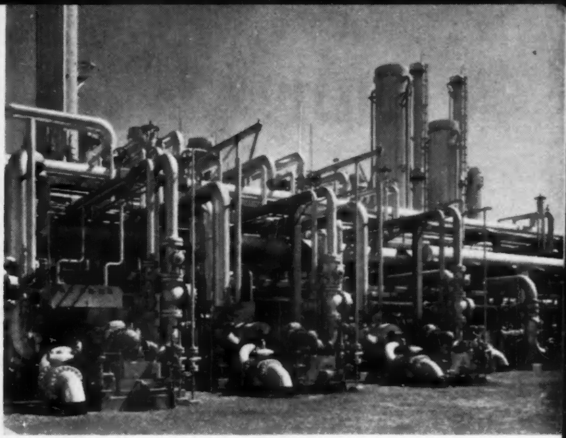
Strangely enough the picture on our cover can be termed a "bird's eye" view. What looks like the framing of a building is the steelwork for the nest in which a deadly Atlas missile will soon rest. The "bird" itself and accessory equipment in the silo are protected from ground-transmitted shocks by the heavy spring shock mounting visible high on the walls. The cribbing is one of the final steps in making our missile forces immune from sneak attack. Prior stages are pictured and discussed in the lead article.

DEPARTMENTS

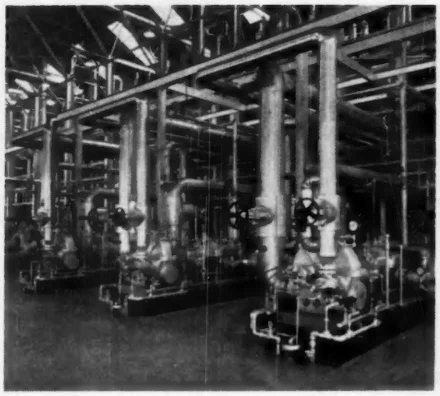




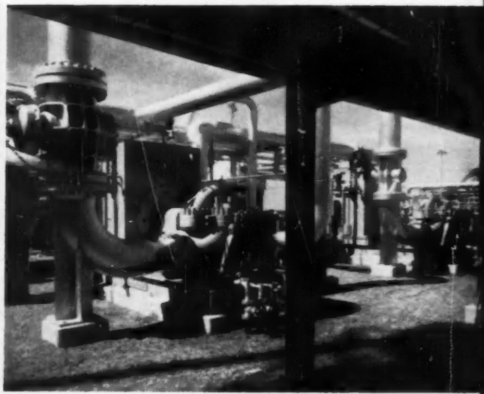
Five Ingersoll-Rand VHTB multi-stage vertical pumps for handling propane and butane at shipping terminal for distribution to product pipelines.



Three Ingersoll-Rand HMTA four-stage pumps specially designed with one interstage bleed-off connection to combine two lean absorption oil services for pressure levels of 480 and 1000 psig.



Three of four Ingersoll-Rand CNTA eight-stage boiler-feed pumps operating at a discharge pressure of 750 psig.



Two Ingersoll-Rand BHV hydraulic turbines designed to recover power from the high and low pressure rich oil stream to drive a 1500 hp and 1000 hp induction generator.

Two of three Ingersoll-Rand CHTA six-stage, barrel-type pumps specially designed with two interstage bleed-off connections. Three lean absorption oil services are combined in one pump for pressure levels of 1000, 1270 and 1880 psig.

S PLANT there are 104 centrifugal pumps in various services.

- a total of 20,000 horsepower.

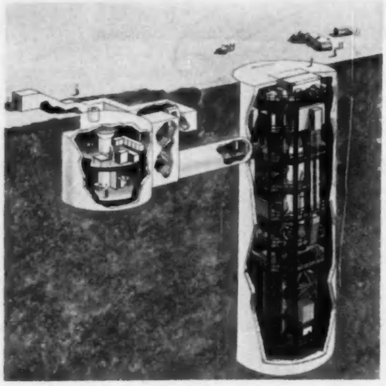
Ingersoll-Rand®

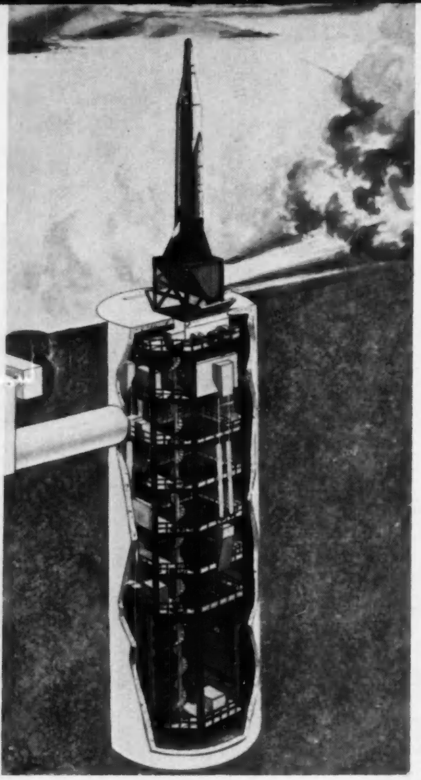
270A10 11 Broadway, New York 4, N. Y.

MORE THAN A CENTURY OF PUMP PROGRESS

Our Missiles Go UNDERGROUND

R. J. Nemmers





BALLISTIC missiles have been likened to the big sticks spoken of by President Theodore Roosevelt when he said "Speak softly, but . . . ." According to military experts, in any period there is a big stick—a pre-eminent weapon—that must be taken into consideration in all war and defense plans, even in all phases of international diplomacy. There is no doubt that the pre-eminent weapon is the ballistic missile with a nuclear, or thermonuclear, warhead. In the free world these missiles carry names as Polaris, Thor, Titan, Minuteman, Jupiter and Atlas.

We are engaged in a building program unique in United States history—the preparation of an invincible attack force while at peace. Traditionally we have limited our peacetime construction of war potential to the minimum needed for defense. But against today's big sticks, there is little or no defense save a better offense. Thus we are building something new in a war machine—a deterrent force to make the risk of starting a war too great for any aggressor nation.

Already at sea are five sleek nuclear-powered fleet ballistic missile submarines each carrying sixteen deadly Polaris missiles that can be launched "out of nowhere" from a moving, almost impossible-to-find base. (*Compressed Air Magazine* will feature an article on the Polaris air-powered launching system in the near future.)

At this writing there are eighteen Atlas intercontinental ballistic missiles (ICBM's) operational, and another eighteen should be ready for duty by the time this material is published. A squadron of nine Titan I ICBM's may also be in action, with more Atlases and Titans to follow in steady order. Readying this ICBM fleet is described as the biggest defense construction project since the building of the Manhattan structures under strict secrecy during World War II. It involves the construction of 21 launching bases for some 430 intercontinental ballistic missiles. The bases blanket the country and should be quite complete by 1965 at which time about $15 billion will have been expended to make them ready for a task that all peoples fervently pray will never be necessary.

The land bases now under construction in the continental United States will handle 133 Atlas ICBM's at eleven locations, 131 Titans at ten locations and 165 Minuteman missiles at a single location. A second site for Minuteman missiles is under consideration with nests for 150 more. Atlas and Titan are liquid-fueled rockets; Minuteman, solid-fueled.

All of the now-operational Atlas missiles are D models, a type that requires radio-directional guidance from ground stations after launching. These missiles lie horizontally in "soft" (above ground) bases at Warren AFB (Air Force Base), Cheyenne, Wyo.; Vandenburg AFB, Lompoc, Calif.; and Offutt, AFB, Omaha, Neb. Atlas E's are coming into use at Fairchild AFB, Spokane, Wash., and Forbes AFB, Topeka, Kan. The E-type Atlas has a built-in inertial guidance system that requires no radio signals from the ground base to direct it.

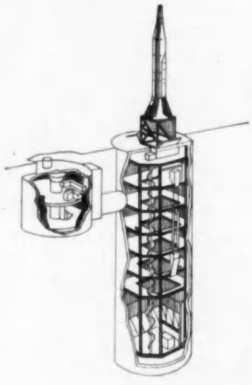
The Fairchild and Forbes sites are the so-called semihard variety: they consist of concrete coffins housing the missile in a horizontal position, and lie just below ground level with the top showing.

The next step in the building of our deterrent force will be taken early next year when the first of the so-called hardened sites will become operational. Unlike previous ones, each will house improved Atlas F missiles vertically in an underground silo. Each will average about 170 feet in depth and will be surrounded with massive reinforced concrete. Each is far enough from others in its squadron so that it will remain in operation even if its neighbor is struck. There is, of course, no requirement for elaborate ground control centers to guide the missiles.

At the soft and semihard sites, the horizontal missiles can be raised and fired with a countdown of about 15 minutes for fueling. In the vertical silos, the countdown is shorter because the RP-1 fuel (essentially kerosine) that is used in the Atlas can be stored aboard the rocket. To fire the weapon, it is raised to the surface and loaded with liquid oxygen oxidizer.

In 1963 the fourth generation missile squadrons should be ready for duty. These will include silos similar to the hard Atlas and Titan I sites and will contain the liquid-fueled Titan II and the solid-fueled Minuteman missiles. The Titan II can store on board all of its fuel, and both missiles can be fired from the silo without raising them to the surface, a factor that will make them even more invulnerable to attack.

MISSILE BASES IN THE UNITED STATES. NUMBER OF "BIRDS" IS INDICATED INSIDE KEYED SYMBOLS.

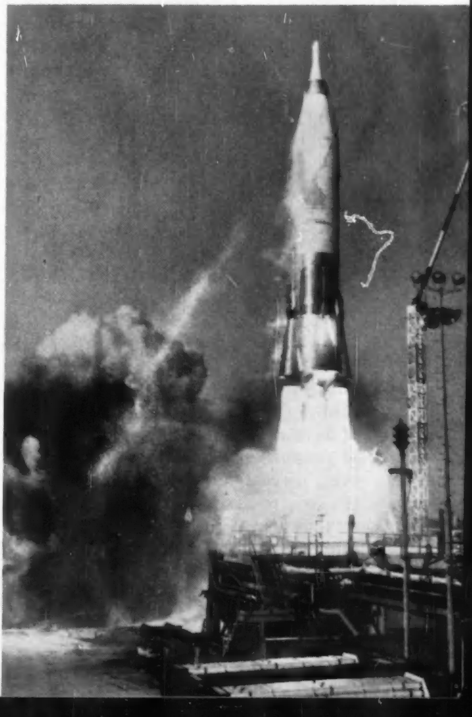


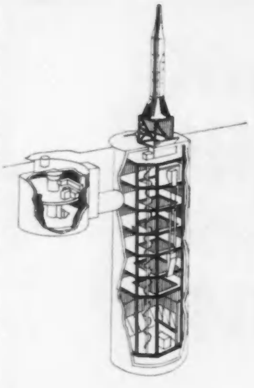
About The Atlas

THE ATLAS missile itself, with an operational nose cone, is 82⅓ feet high and 10 feet in diameter. At launch it weighs about 260,000 pounds (130 tons), of which more than 90 percent is fuel. Its thrust at take-off is about 360,000 pounds, increasing to well over 400,000 pounds at altitude. After the boosters are jettisoned at staging, the sustainer rocket provides a thrust of 80,000 pounds. The engines themselves are fueled by RP-1 and liquid oxygen. In addition to the twin large boosters and the single sustainer engine, there are two small vernier or trim rockets for guidance.

The main structure of Atlas is a tough, lightweight stainless steel tank with skin thinner than a dime. (The thickest steel in the tank is 0.04 inch, and some of it is much thinner. The steel is a special cold-rolled austenitic material now known as AISI grade 301.) The tank is the full 10-foot diameter of the Atlas and is about 60 feet in length. It has no internal bracing, but rather maintains its shape by internal pressure, just like a football or basketball. And, like a football, it can withstand brutal punishment. During handling in the factory, transportation, and erection on a firing pad, an internal pressure of less than 10 psig is maintained. With this internal pressure, the tank can be struck heavy blows with a hammer without being permanently dented. Like a football, it "gives" or deforms elastically with impact. During flight, internal pressures of more than 10 psig are customarily maintained to push the fuel and oxidizer to the engines. A single, stainless steel, central bulkhead separates the tank into two sections, the aft, or bottom, one for RP-1; the top, or fore, section for liquid oxygen.

AN ATLAS RISES FROM LAUNCHING PAD DURING TESTING AT CAPE CANAVERAL





Sinking The Atlas Silos

FROM the standpoint of immediacy of service, the Atlas site construction program is the farthest advanced of all. The project is one in which compressed air power has played a role of considerable importance in all cases, but for varying tasks. Rock drills and pneumatic tools, pneumatic cement guns, pumping and hoisting equipment, all have been used by the six contractors building the half dozen hardened sites that in months to come will carry a large share of the nation's defense load. On the following pages we conduct you on a pictorial tour of some of the representative sites.

The Atlas program is under the control of the Ballistic Systems Division, commanded by Maj. Gen. Thomas P. Gerrity, of the Air Force Systems Command. Construction, installation and check out of the bases are under the supervision of Brig. Gen. Alvin C. Welling of the U. S. Army Corps of Engineers, who is Deputy for Site Activation of Ballistics Systems Division. Building of each squadron has been let to a general contractor.

The six hardened sites are located as follows, with the April 1 percentage of completion figure (main construction contract) following in brackets: Schilling AFB, Salina, Kan., (95 percent); Lincoln AFB, Lincoln, Neb., (88 percent); Altus AFB, Altus, Okla., (78 percent); Dyess AFB, Abilene, Tex., (76 percent); Walker AFB, Roswell, N. M., (48 percent); and Plattsburgh AFB, Plattsburgh, N. Y., (37 percent). All now are essentially on schedule, or close enough to being on time that no difficulty in meeting operational schedules is expected.

The mythical "average squadron" will cost about $178 million when complete. This compares to the average Titan (9 missiles) group cost of $130 million; and Minuteman squadron (50 "birds") price of $110 million. Because of the variety of ground conditions encountered, however, there is no truly "average" squadron, or even individual site. The group surrounding Schilling AFB was let to a joint venture, Utah-Manhattan-Sundt, at a price of $23,383,000 for twelve sites. The one at Lincoln went to Western Contracting Company for $17,400,000 for nine sites; at Altus, to Morrison-Knudsen, Inc., and Paul Hardeman & Associates, Inc., a joint venture, for $20,926,500 for twelve sites; at Dyess, to Zachry-Brown, a joint venture of H. B. Zachry Company (sponsor) and Brown & Root, Inc., for $20,075,000 for twelve sites; at Walker, to Macco (sponsor), Raymond, Kaiser & Puget Sound, also a joint venture, at a bid of $22,115,829 for twelve sites; and at Plattsburgh, to the same combine, but with Raymond International, Inc., as sponsor, for $24,408,000, also for twelve sites. All 72 of the silos in the hardened squadrons are identical. Each has a finished depth of 174 feet and internal diameter of 52 feet. With each silo is a Launch Control Center, also underground. The so-called LCC's are cylinders 38 feet in diameter and 27 feet in depth, the floor being 38 feet below top of silo. Each is connected to its silo by an underground tunnel 8 feet in diameter and 15 feet long. These intercept the LCC's at the bottom (38-foot) level.

Excavation techniques differed from site to site and from contractor to contractor, but in general, all followed essentially one pattern. After the site had been cleared and grubbed, heavy earthmoving equipment scooped out an egg-shaped depression in the overburden to a depth of about 40 feet. This depression averaged about 300 feet in length and 200 feet in width. One engineer observed that the completed dips would make a good start for a football stadium. This approach meant that the LCC's could be built at ground surface and that actual shaft sinking was reduced to about 135 to 140 feet. It was subject to considerable variation, however, depending on the depth at which rock was encountered. For example, at Plattsburgh Site 8, a hard dense sandstone was encountered only 4 feet below soil surface. Dozers shoved the topsoil aside in the immediate area, the silo and LCC were collared and each sunk its full finished depth. Taking all sites at all squadrons into consideration, rock was hit at levels ranging from surface on down to the bottom, some silos being excavated entirely in combinations of silt, sand, clay or decomposed shale that required little or no rock drilling and blasting.

Where no rock was encountered, the contractors involved used rippers to loosen the muck, and air-operated, track-mounted overshot muckers or diesel-powered front-end loaders to scoop it into buckets. Mobile cranes were used at many sites to remove the muck from the holes, but skip hoists were used at some silos. Whenever ground conditions permitted, excavation was generally carried all the way to the bottom using wire mesh to support the ground behind segmented H-beam rings. These were installed on various centers, depending upon the type of earth or rock. Usually the mesh was heavily gunited.

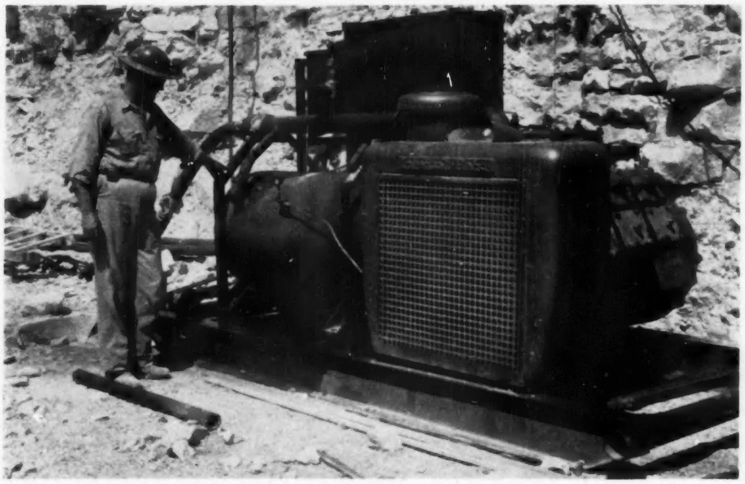
When any appreciable amount of rock was encountered, most contractors used heavy-duty crawler-mounted boom-type drills of $3^{1}/_{2}$- to $4^{1}/_{2}$-inch bore to put down holes of $1^{5}/_{8}$- to $2^{1}/_{2}$-inch diameter and in some cases even larger. Rounds varied among the contractors, some shooting as much as 20 feet in a single lift across the full bottom, and some lifting only about 10 feet across half the bottom. When the builders ran up against only shallow seams of rock, hand-held Jackhamers were used to shoot them in one or two lifts. In some silos, large boulders requiring pop-holing were encountered and hand-held drills were used in these cases, too. Powder factors varied from 0.2 pound per cubic yard or lower in isolated seams, to more than 1 pound per yard in the hard rock country, with, of course, extremes on the upper end of the scale.

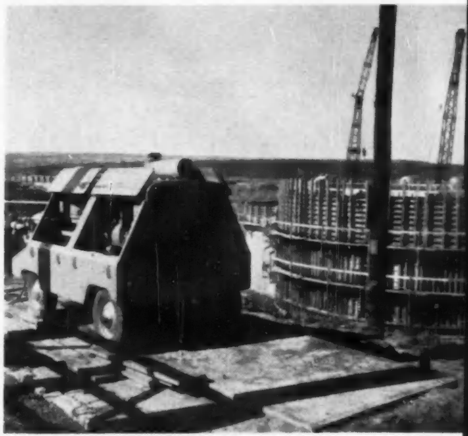
Naturally water was encountered in many of the holes and the methods of dealing with it varied depending on the soil and quantity. At one Schilling site, well points were drilled in place and the water table successfully lowered. In rock areas, minor grouting sealed many water-bearing strata, while in other areas, complete grout curtains had to be put down to control inflows. No caisson work was required, however.

The bottom two-thirds of each silo are lined with a minimum of $2^{1}/_{2}$ feet of reinforced concrete. The upper third batters out on a 4:1 slope finishing at a uniform 9-foot thickness of concrete through the uppermost 30 feet of the silo, the interior dimension remaining the same. At the collar area then, the shafts as excavated had a diameter of roughly 70 to 72 feet, narrowing down to about 58 feet in the lower section. As we said, the shafts were bottomed prior to lining where possible, and then slip forms used in the pouring of the walls from the bottom up. (At the Walker site, standard forms were used because Type V cement was necessary due to presence of sulphates in the surrounding soil.) The job resembles slip forming of grain elevators: indeed, the resemblance is so close that at Dyess, Johnson Elevator Company, which specializes in building grain elevators, was awarded the subcontract for slip forming operations.

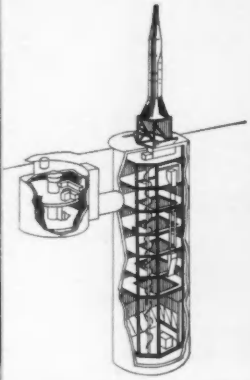
The concrete lining is heavily reinforced. At Dyess sites for example, No. 8 rebars were used in the lower $2^{1}/_{2}$-foot-thick sections, being placed on a 9×9-inch square pattern. The upper, thicker sections utilized No. 18 bars on 14-inch centers. Throughout the country, and depending on overbreak, about 7000 to 7500 cubic yards of concrete was required for each site.

Air Power





The quantity of compressed air used on the Atlas silos is staggering. One rough estimate is that an average of at least 600 cfm was required at each of the 72 sites throughout the construction period. Compressor installations ranged from the single 900-cfm Gyro-Flo shown at top right to the battery of three 900's at the left. Both pictures are of Plattsburgh sites, the former taken when concreting was just getting under way, the latter during full-scale drilling. Work went on in all temperatures, from the near-zero at Plattsburgh as shown by the partially closed radiator covers on the portables, to the 100° F and more at Schilling where center left picture of two 900's was taken. Portables of the 365-cfm size were extensively used to power concrete vibrators as shown in the two pictures at right, above. The upper one was working at a nearly completed Schilling site, the lower at an Altus location. Stationary air supplies were used by the contractor at Dyess locations, with one of the Ingersoll-Rand Type 40 skid-mounted 125-hp compressors shown in the picture at left, above, at each of the twelve sites to supply air for miscellaneous jobs. When more air was needed for drilling, portables were dispatched from a central supply headquarters to fill in.



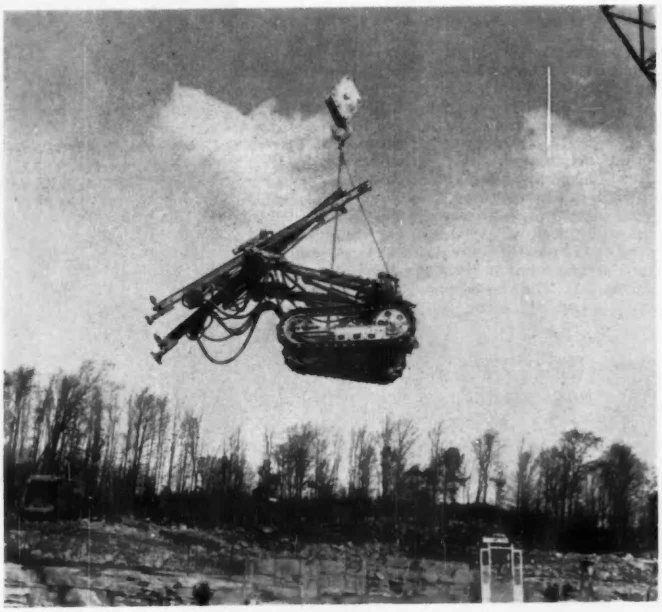
PREPARATION

After clearing and grubbing the site, an egg-shaped depression about 40 feet deep is scooped out. Dozers and draglines handled this chore as shown in the picture at left taken during early stages of a Plattsburgh site. This permits the Launch Control Center (LCC) to be built from the ground up, and also brings the 4:1 batter slope of the top of the silo above ground level. After the silo is concreted and the LCC built, the site is backfilled. The aerial view, also at Plattsburgh, shows the approach used when rock is encountered at the surface—both the silo and control center are sunk with little or no backfill required. The other picture shows beginning rock work at a Dyess site.

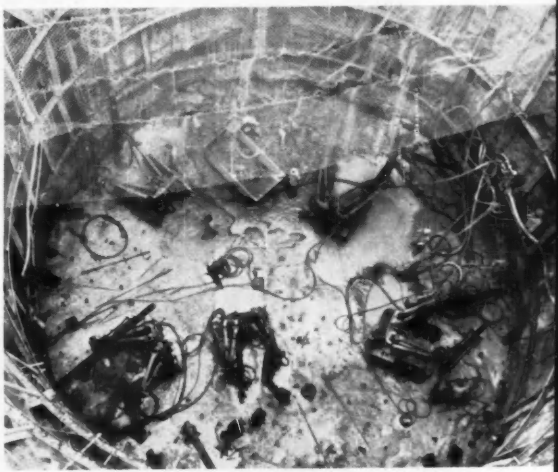
About Drilling

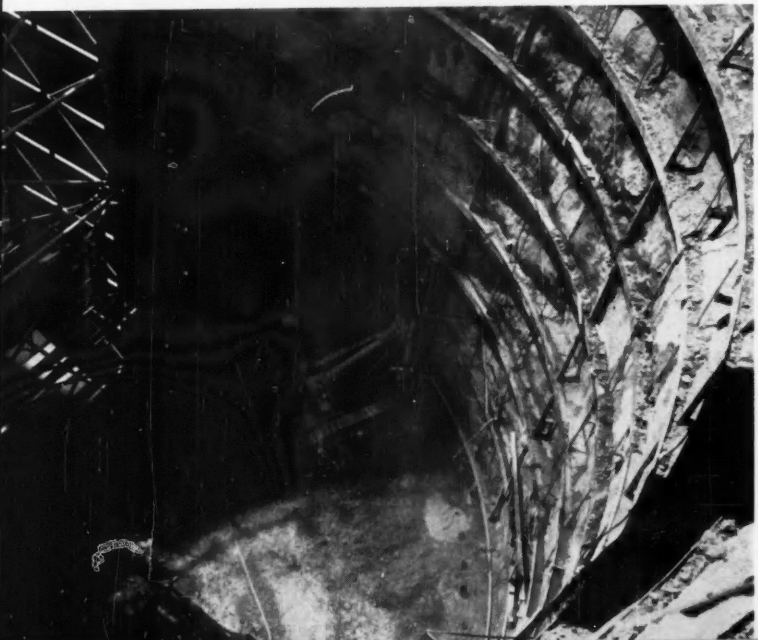
Symbolic of drilling operations at many sites is the picture at the top of the next page showing a unit poised high over a Plattsburgh hole before being lowered to begin work. The pictures to its right show several of the machines at work. These are Ingersoll-Rand Crawl-IR's with double booms, each mounting a DC-35 drill. As many as five of these rigs worked in a single Plattsburgh silo at a time, as shown in the lower one. Usual drilling practice here called for a single boom Crawl-IR to drill perimeter holes for precracking (line holing) on 15-inch centers to depths of 20 to 30 feet using D-45 drills and $2^{1}/_{2}$-inch carbide bits. Single-boom D-40's with $1^{3}/_{4}$-inch bits and the dual-boom, DC-35 rigs, with $1^{3}/_{4}$- and $1^{5}/_{8}$-inch bits, then drilled out 10-foot rounds to lift 8 to $8^{1}/_{2}$ feet of rock. A total of ten Crawl-IR's with D-45's, seven with D-40's and ten dual rigs with twenty DC-35's were in use at Plattsburgh at one time. Ten 900-cfm Gyro-Flo's and ten 600's were required for air supplies during that interval. The dual-boom rigs were handy for clean-up work around the perimeter, too. Very hard and dense, coarse and medium grained quartzites, shales and sandstones were encountered at Plattsburgh sites, along with some granites, gneiss and syenite.

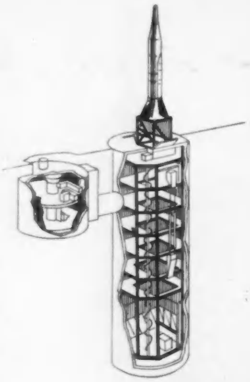
At Dyess sites, seven Crawl-IR's were used on a very rigid schedule, being dispatched as needed from site to site. The seven units drilled a total of 678,000 feet of hole using $2^{1}/_{2}$- and $2^{3}/_{4}$-inch bits to put down 21-foot rounds lifting 20 feet at a shot. One of the units is shown drilling in the bottom left picture, and four of them, just collaring a shaft, in the picture just above. Approximately 250 holes per round were required and, in one shaft, a single round was drilled out in only 11 hours. Rock at some Dyess sites could be ripped with suitably equipped 'dozers. Hand-held Jackhamers had jobs to do on the silos, too. As shown in the picture at the lower right, they were used at Dyess for perimeter trimming. At other squadrons, they were used for all rock work, especially where quantities were small and seams thin. Jacklegs also were in use at several sites to drill $1^{1}/_{2}$- and $1^{3}/_{8}$-inch rock-bolt holes for supporting rib rings.



Drills at Work

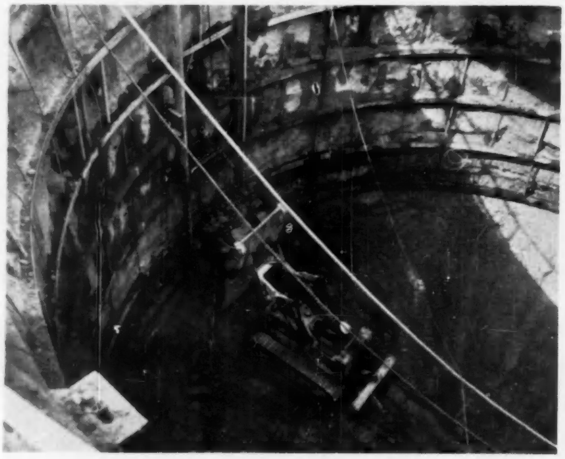


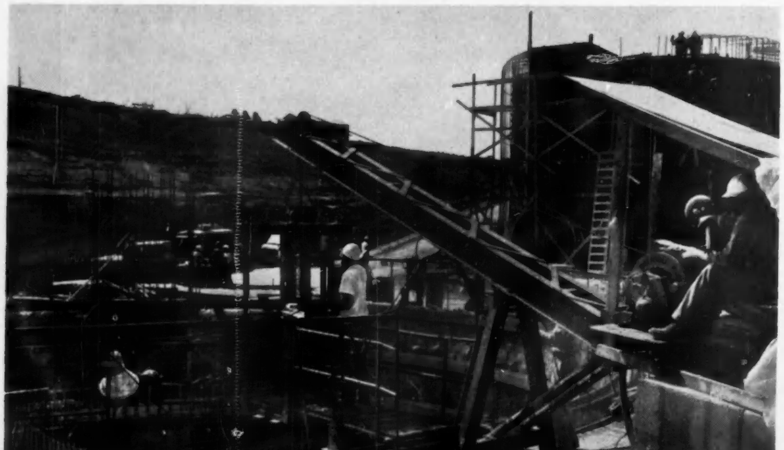




Mucking

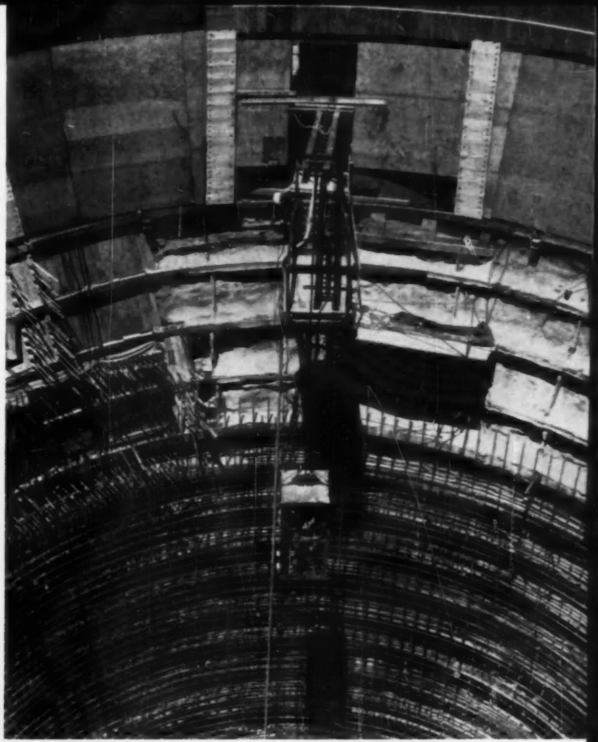
Down below, looking up, the boom and cables of a mobile crane are visible in the picture at right. As shown in the two views below, this was a favored method of mucking by many contractors. Front-end loaders, or in some cases, overshot muckers, loaded spoil into buckets that the crane hoisted from the hole. Shaft depth was considered too shallow to install much in the way of head works. These pictures were taken at Plattsburgh. At Dyess, a skip mucking system was installed in each shaft as shown in the pictures center page. Man hoisting was also done in a variety of ways. At Schilling sites, an Ingersoll-Rand Size K4U utility air hoist worked a small man-cage equipped with special safety dogs (picture at bottom). A unit used at all Dyess sites involved aluminum scaffolding incorporating an elevator hung from a construction bridge down the center of each hole. The bridge was later used in slip-forming concrete. The elevator arrangement is visible in the right center picture of the skip dump mechanism. At other bases, some contractors used a large man-cage suspended from the mobile crane for putting personnel down the silo.

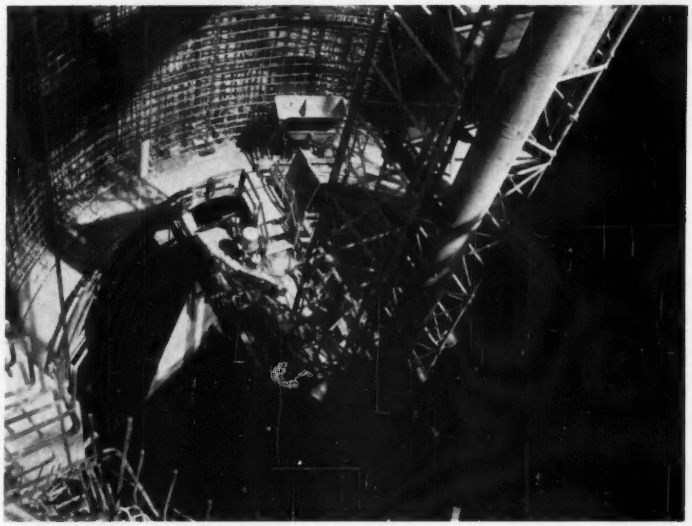




Concrete Work

As the hole was deepened, H-beam rib rings were put into place over wire mesh and the walls heavily gunited (picture below) for wall support. When the hole was bottomed, in most cases a concrete base ring was poured, reinforcing bars installed (right) and the concrete placed by slip-forming. Rates up to 24 inches per hour were attained at Dyess where the concrete was carried to the batter section before rebars were replaced in this heavier area. After reinforcing was in place (bottom left), the remainder of the concrete was poured. Pneumatic vibrators were used at all sites to compact the concrete into a dense voidless mass. Concrete of 3700-psi compressive strength was specified for the silo walls, material of 5000-psi strength for the cap and doors. Exterior forms for the topmost part of the silo are shown in the lower right at a Schilling site, with the opening for the tunnel to the Launch Control Center visible at the lower left of the silo.





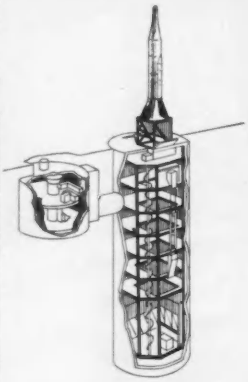
A Building Inside

ENGINEERS point out that each silo could hold a 17-story building of average proportions. The fact is that enough steel goes into each to frame a 17-story structural steel building, although there are but eight main levels involved. The so-called crib inside each silo is made up of eight 12 WF columns heavily cross-braced. Fuel tanks, liquid oxygen vessels, diesel generators, elevator mountings and sheaves and a variety of other equipment so large as to make the presence of the 10-foot-diameter missile seem almost incidental, are spotted and threaded amongst the cribbing. The steel that goes into each crib weighs roughly 320 tons and is assembled with about 13,000 high-strength steel bolts.

Perhaps the most interesting point about the cribs is that they do not rest on the bottom, but are suspended from four spring shock mountings high on the walls of the silo. The usual method of erection is to build the crib in place and resting on blocks. The load is then taken up by jacks when erection is complete, the blocks removed, and the cribbing lowered onto the shock mountings. Shocks from earthquakes and bombs alike are thus prevented from interfering with missile launching in all but the most severe cases. Silos and control centers, of course, are completely underground, thus the depressions cut at the beginning of excavation have to be backfilled. These open cuts were tamped with heavy tractor-drawn rollers, however in areas close to the silos, air-operated backfill tampers were used.

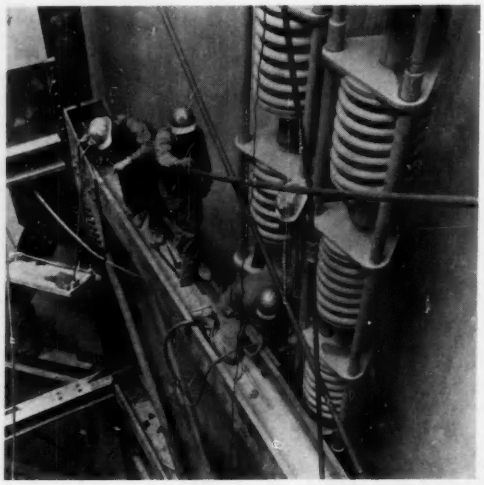
Capping the silos is about the last operation to be performed. The roof is 9 feet thick, heavily reinforced and contains a pair of massive interlocking doors each 18 x 28 feet in size and 4 feet thick. When opened, the missile rides up on its elevator to firing position at surface level. A blast deflector on the elevator deck rises to the surface with the missile and prevents the exhaust from blowing down into the silo.

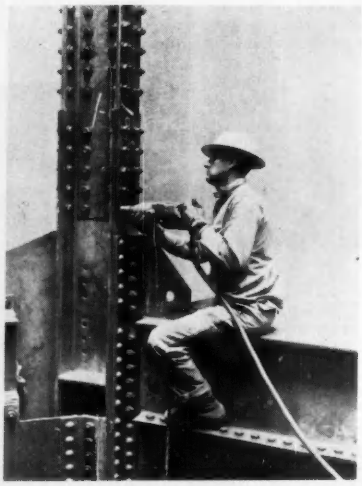
(pictures overleaf)



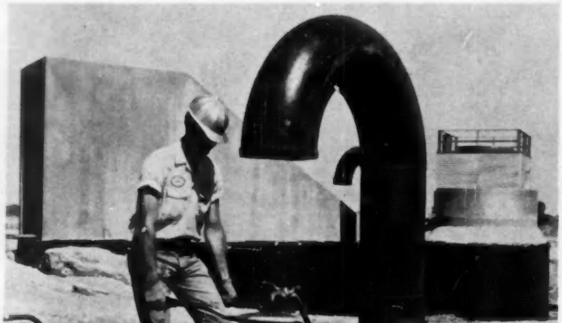
Steel Erection

The hundreds of tons of steel going into each silo are fastened together with some 13,000 high-strength bolts of $^3/_4$-, $^7/_8$- and 1-inch diameter. These three pictures, taken at Dyess sites, show the use of pneumatic Impactools for this work. The tools are Ingersoll-Rand Size 834 units of 1-inch drive and weighing just over 20 pounds, permitting their use in tight corners (sometimes with a universal joint extender). Two men worked with each tool, one placing the bolts and starting the nuts, and the other running them. Some other pneumatic tools also were at work, including Size 810 Impactools for smaller bolts, and Size 6A riveting hammers for driving barrel pins. As shown in the center picture the steel work inside the silo was suspended from enormous spring mountings to isolate equipment and the missile inside.

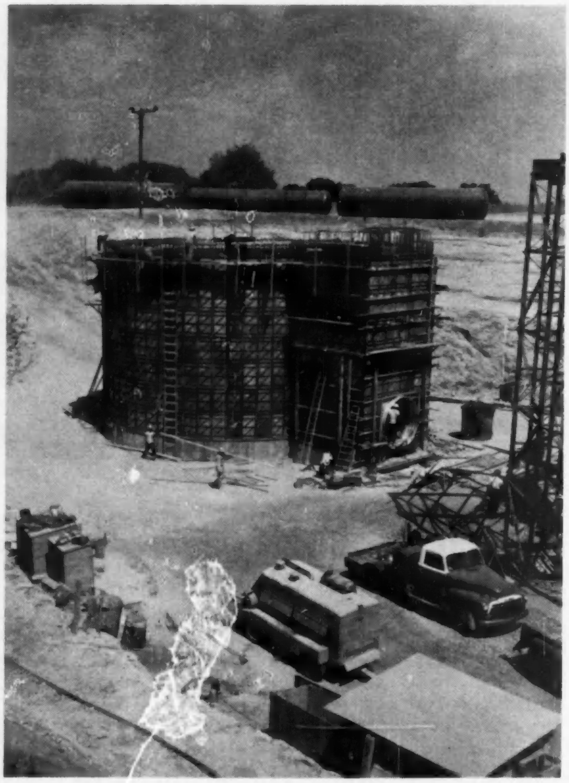




Finishing Touches



BACKFILLING Big sheepsfoot or rubber-tired compactors do the majority of tamping of the backfill materials, but around the structures and small service lines, hand-held pneumatic tampers were brought into use. The Ingersoll-Rand Triplex tamper shown here working around an air intake has about five times the capacity of a single machine. In the background, left to right, are the LCC entrance tunnel, another air intake and the LCC escape hatch. Backfill will be placed to the line of the waterproofing material visible on these structures.



CONTROL CENTER Almost lost in the discussion of the bigger silos, the control centers, too, were being built as work in the deep shafts progressed. Shown here, ready for concrete pouring, is an LCC at a Dyess site. The large tanks in the background are part of the ground support equipment for the Atlas.

CURTAINS OF AIR

Peter Sleight

THE ADDRESS is 901 Washington Boulevard. The city, St. Louis, Mo. The structure, the Bank of St. Louis Building. People passing by do the human thing. They stop and stare, not so much at the gleaming marble and glass front, but at the doors—or rather the lack of doors.

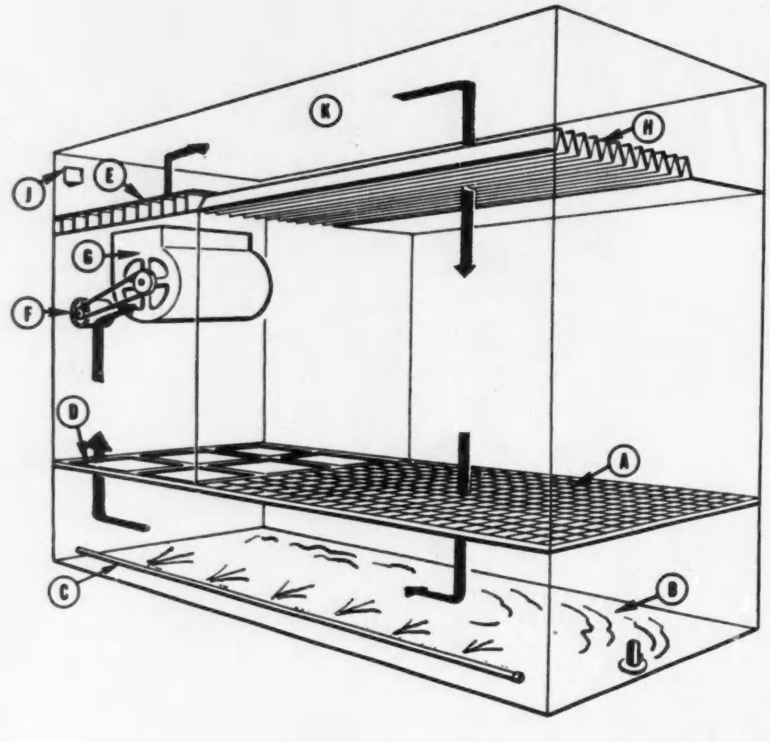
This is one of about 150 American Air Curtain installations in the U. S. Air doors are fast losing their curiosity status, they have too many applications. Engineers and architects are aware of this and are taking a close look at the potential. Manufacturers of the doors are pushing ahead vigorously in a campaign to educate all in the many advantages and applications of curtain-of-air installations in both commercial and industrial buildings. Industries, for example, intent on finding every means to reduce costs, find air doors effect budgets most often in sections headed "Materials Handling," with heating and air conditioning allocations close runners-up.

While the door is always "closed," it is also always open, allowing heavy traffic loads to pass without delay. Freight cars, trucks, jitneys and personnel can move freely. Where conveyors transport material to and from buildings and stock piles, or workpieces through paint booths and baking ovens, air doors are ideal to keep the material moving with the least interference.

Other applications are at the ends of automobile assembly lines, and in papermaking, packaging, canning and bottling factories, for insects are discouraged from passing through a curtain of air. Where temperature must be controlled, air doors can separate cold storage warehouses of, say, $-10°$ F from open loading docks. Walk-in freezers may soon be another use. In regions of smaller temperature variation—an air conditioned manufacturing bay and an un-air conditioned storage section—a curtain of air will save cooling costs, for it reduces to a minimum moist air entering and freezing over cooling coils.

It is thought that eventually curtains of air will find their way from hotel lobby doors to roof gardens, or even onto sidewalks for cafes that can operate the year around. As one recent advertisement said, "it keeps out summer heat, winter cold, snow, wind, rain, dust, fumes and insects." The future may even bring curtained hot houses, solariums and swimming pools.

COLUMBUS, OHIO **This 33-foot Air Curtain door at the Lazarus Department Store has been in use since 1957. Note how air flow does not "flip a skirt or mess a hairdo."**



Operation

The circulating system of a typical air door consists of ten major parts: the floor grating (A), which ideally is composed of 1/4-inch openings so slim heels will not be caught; a pit (B), which contains a spray system (C) to eliminate fire hazards from dropped cigarettes; filters (D), which can be maintained easily; heating or cooling coils (E); an electric variable- or multi-speed motor and blower (F and G); directional air nozzles (H); a Weather-Sight (J); and a plenum duct (K). These are shown in the accompanying schematic. Here is how they function as an air-recycle package:

Air is drawn down through the grating and passes through the pit with its water spray pan. It is pulled up through filters by the blowers, sent through the heating (or cooling) coils, into the plenum. Air nozzles direct the discharge down through the door opening, straight or at an angle which can be varied to cope with wind conditions. The air then recycles through the grating to be cleaned, filtered and conditioned before being recirculated. At predetermined intervals, the spray system flushes dirt and debris (that are sucked down through the grating with the air and removed from the stream by the water pan) down a drain in the pit.

The fact that the air is constantly cleaned and filtered adds to the applications of air doors. They can be used in chemical plants not only to keep toxic fumes from penetrating the entire site, but to remove dangerous or unpleasant chemicals from the air. Hospitals find they not only isolate sterile rooms, but help keep them clean too. White-room doors would reduce air escaping and keep dust off all objects entering. Perhaps bomb shelters could be equipped with air doors and windows to protect occupants during a chemical attack.

Operating equipment can be installed above, below (either basement or simply subgrade) or at the side of the doorway, as shown, depending on the amount of space available. Air can be made to flow vertically or horizontally, but the former is far more prevelant in existing installations. Horizontal flows are rapidly becoming popular for industrial installations, reports American Air Curtain, for they are more economical to install—they do not require a pit. But where customer comfort is essential, as in a store or bank installation, vertical flow is a must. Air velocity would do the job without "flipping a skirt or messing a hairdo."

The vertical unit illustrated is fabricated by AAC and installed by the purchaser's maintenance crews or by heating and air conditioning contractors. General Electric Company, which has one of the highest (18 feet) doors in the U. S., at its River Works, Lynn, Mass., divided the job into two parts: design and fabrication of equipment and installation on the site; and design and installation of the foundation, plenum pit and services which was done by General Electric's Plant Utilities—Plant Engineering & Construction Unit.

Selection

Modifications of standard AAC air doors as well as custom-built units are available. Night doors can be added if desired—sliding, swinging or showcase ones that disappear into the floor during business hours are satisfactory. In Europe, vending machines are presently used as doors. In areas subject to gale winds, hurricanes and the like, doors are definitely advised.

In selecting the proper type and size air door, building height, traffic volume, interior and exterior temperatures, stack effect, wind velocities and directions, adjacent buildings and their effect on air pressure at the proposed entrance, and the building configuration itself are all to be considered. The possibilities of interior pressurized air and potential air leaks are also studied.

Once these factors are evaluated, the proper air door can be designed. For narrow entrances, it is, of course, more economical and the installation can be completed quicker if a standard package unit is selected rather than a custom-built one. Cost normally varies between $750 and $1000 per foot of entrance width. (Operating costs, including such utilities as heating, averages 20–30 cents an hour for a 10×8-foot entrance.) Sizes vary considerably. Some air curtains are 50 feet wide, but there is no limit as to width. Heights are generally 8 feet, but larger ones are entirely possible, according to company spokesmen. On widths greater than 12 feet, dual ducts are recommended. Single return ducts can be used to 12 feet. These are usually metal, but should the architect specify it, they can be made of any material, including glass. Many banks prefer glass plenums.

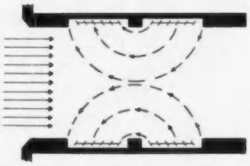
History

Curtain of air is not a new principle. Its history dates from nearly the turn of the century. Essentially a Swiss invention, it is based on principles known for many years. One of the early successful applications was in the Oscar Weber Department Store, Zurich, Switzerland. The door was developed and put into operation by Sifrag of Berne in 1952.

Probably one of the first patents was granted to Theophilus Van Kennel, 1904. His curtain sealed an entrance from outside air by blowing air through nozzles from both sides of the entrance (see

INPENETRABLE This industrial entrance is at Hopper Paper Company, Taylorville, Ill. Notice that even the fumes from a fire extinguisher, simulating outdoor wind, will not pass through this Air Curtain installation.

sketch). The door was quite small and apparently was never put into practical use.



In 1916, an American named Caldwell applied for a patent to blow air through nozzles above the entrance of a building. Similar to today's doors, a floor grating received the down flow. This grating was divided into two sections. The cold outside air was drawn in by the outer half of the grate and blown through ducts to the outside of the building. Warm air introduced through nozzles above the entrance was drawn by the inner part of the grate and introduced to the inside of the building.

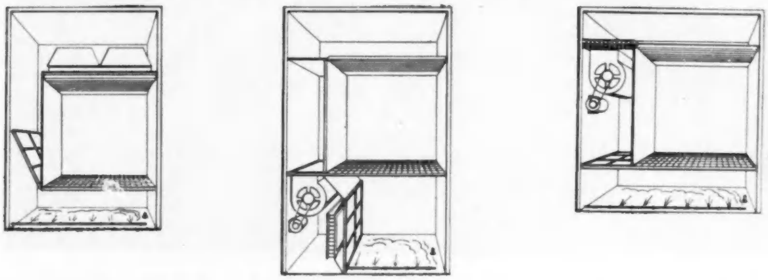
Other applications followed in quick succession—blowing flies and dirt from barn doors, separating theater stages from heat of lights. All were theoretically good; none were particularly successful because the air stream was too thin and the velocity unchangeable.

Sealing

The air sealing capacity of an American Air Curtain installation is accomplished by the depth of the air mass (measured by the width of the grille), and the angle of discharged air, which can be automatically varied according to prevailing wind pressures or pressure differential at the entrance by a Weather-Sight device. Details of the moveable nozzles are shown below. By varying the direction of the nozzles, delivery of a uniform and nondiffusing curtain having a velocity and mass to resist the pressure differential between two sides is permitted. For personal comfort, velocity has been restricted, of course. Where insects are not wanted, velocity must exceed 100 feet per minute. Some industrial applications will function nicely with much higher velocities.

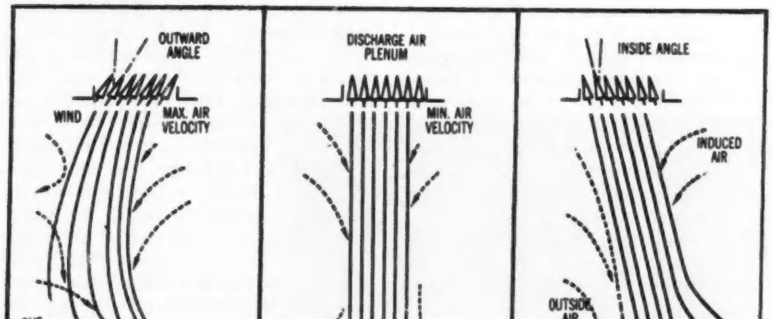
The Weather-Sight is actuated by pressure differential outside and inside the building. Both the air discharged through the nozzles and the blower speed are regulated to maintain the proper balance of air pressure with the inside and outside pressures at all times. When changes in atmospheric temperature occur, a thermostat changes the temperature of the circulating air to preserve the proper relationship to that within the building.

An automatic control panel regulates the blower motor for either automatic (by the Weather-Sight) or semiautomatic operation; heating or cooling, depending on local conditions; and operation of the water supply. Depending on geographic location and exposure, heating capacity of 25,000 to 50,000 Btu per hour per foot width of door is needed. When cooling, only 5000 to 10,000 Btu per hour per foot width of door is required. Generally the heat supplied is the same as the usual door service load—or even less.



INSTALLATION PLACEMENT The operating equipment of American Air Curtain doors may be mounted at the side (left), in the basement or below grade (center), or at the top (right). It depends on the space the customer has available.

SEALING The air sealing capacity is accomplished by American Air Curtain nozzles assembly (below) which delivers a uniform and nondiffusing curtain of air having a velocity and mass—depth of curtain—to resist the pressure differential between the two sides.



Saving

Research has shown that in Washington, D.C., Boston, Mass., and Chicago, Ill., during normal cold weather, 1100 cubic feet of air flows into a building everytime the conventional door was opened. In Detroit, Mich., where 15,000 people enter and leave a building a day, heat losses amount to $6400 annually. In a building where air conditioning is popular, hot summer air entered at a rate of 150–180 cubic feet, increasing air conditioning costs by 25 percent. As much as 165 cubic feet of air enters through a 36-inch-wide swinging door with every person. When 150 people pass through an hour, this is equivalent to the loss of at least a ton of refrigeration.

Cost savings with air doors could result from decreasing these heating and cooling expenditures, a reduction of accident claims, lowered door maintenance and repair costs, an increased work area that formerly was taken up with vestibules, reduced cleaning bills, and increased traffic flow.

Allegheny Ludlum Finds Five Reasons to. . .

Forge with Air

SEVERAL years of experience with compressed air to drive forging hammers have pointed up five specific advantages of air over steam at Allegheny Ludlum Steel Corporation's facility in Ferndale, Mich.

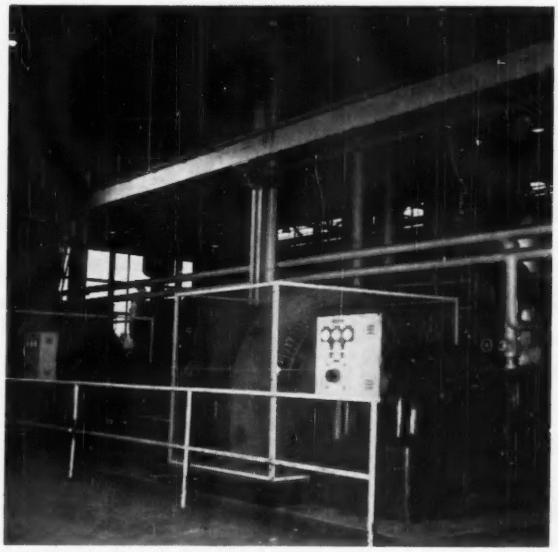
Home of the company's Forging & Casting Division, the plant produces hammered forgings, composite die sections and cast-to-shape tool steels. Working mainly as a specialty job shop for the tool and die market, the division's customers come from the automotive, aircraft, petroleum and food processing fields. The U. S. Navy and the AEC are also on the list.

The move from steam to compressed air was prompted mainly because of steam pressure deficiency problems. The forge shop at the Ferndale plant (the town is a suburb of Detroit) has ten hammers varying in size from 1500 to 6000 pounds.* Of the 175 men employed in the plant, about 50 handle operation of the hammers. When all ten of the husky forge units were in operation, steam pressure would fall off quickly. Occasionally the pressure was depleted so drastically that certain of the hammers had to be shut down so that pressure could be built up again. This loss in working pressure, of course, meant that men and machines both were idle while there was work to be done—a costly situation. This could also eventually translate itself into delayed shipments to customers. The situation had to be remedied.

After studying the problem, the plant officials decided to switch the entire forging operation to compressed air power. A compressor manufacturer's sales engineer was called in to study the problem and make recommendations. The result was the installation of two heavy-duty Ingersoll-Rand PRE-2 compressors. These are 30&18×22 units driven by 600-hp motors at 200 rpm each supplying 3580 cfm of air. They were placed in the forge shop within 200 feet of all ten hammers. Receivers were not installed, instead a 24-inch header line runs from the compressors in a loop around the length of the shop to supply the extra large capacity of air required by the hammers. When charged, this large line acts, in effect, as a receiver. Air is delivered to the units at 110-105 psig by smaller pipes running from the header. The compressors are equipped with air-intake filters and silencers. Besides furnishing air to the hammer forge section of the plant, the compressors also supply the power for air tools used in the foundry. A 3-inch line runs to the foundry from the 24-inch main supply.

* Forge hammers are rated in foot pounds of striking force. Allegheny Ludlum Steel's Forging & Casting Division employs hammers of the following sizes and makes:

Size	Make
1500-pound	Erie
2000-pound	Niles, Chambersburg
2500-pound	Erie, Chambersburg
3000-pound	Chambersburg
3500-pound	Niles
4000-pound	Chambersburg
6000-pound	Erie, Niles



AIR SUPPLY These two Ingersoll-Rand PRE-2 compressors solved the Forging & Casting Division's pressure problem by ensuring a continuous large supply of air. Ten forging hammers draw air power from the system, as do air tools in the plant's foundry. The PRE's each provide 3580 cfm of 110-psig air and are driven at 200 rpm by 600-hp synchronous motors. The compressors are heavy-duty, duplex, double-acting machines.

HEADER The large, horizontally oriented pipe in the upper part of this photograph carries air from the compressors to the forge hammers. The header has a 24-inch diameter and acts as a receiver for the large quantities of air needed. Pressure drop is negligible because all hammers are within 200 feet of the compressors. Smaller lines feed from the header down to the forging units.

After working extensively with the air system, Allegheny Ludlum Forging & Casting Division personnel found these features as improvements over steam.

1. Recovery of air is much more efficient than with steam. Air not immediately used can be contained efficiently in the large air line.

2. Air is much cleaner than steam. This is important because shop and machine cleanliness are difficult to control in such plants.

3. Over-all maintenance with air is much less than with steam. There is less problem in handling this form of power and it is safer.

4. Hammer operators prefer the more positive—"snappy"—action that compressed air provides.

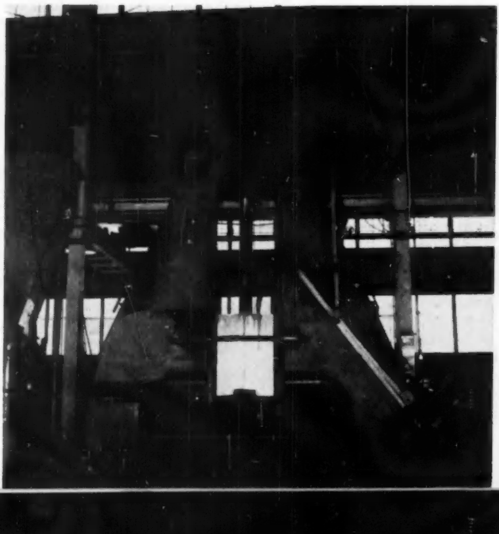
5. The operators also like air because lubrication is easily handled. Nearly enough oil is carried in the air from the compressors to meet the needs of the hammers. Steam tends to sabotage lubrication.

These advantages have combined to help increase efficiency of both the men and machines in the forge shop, and to sharpen customer service. Possible future improvements in the air system are the construction of an enclosure around the compressors to further protect them and to reduce operation noise. (Although isolated from the rest of the shop by protective screens and railing, the compressors currently are exposed in the shop proper.) Another improvement possibility is to insulate the large header line to prevent temperature drop and a subsequent reduction in air pressure.

The forge shop handles some 150 grades of metal and purchases many of its billets from the parent company. The bulk of the sales work for the division is carried out by the 180-odd Allegheny Ludlum Steel salesmen across the country. Four sales engineers based at Ferndale go into the field on special technical inquiries.

Backing up the production facilities is a metallurgical department (a metallurgist and three technicians) who carry out specifications and quality control duties on the 500 metals and alloys the plant as a whole handles. Facilities are available for sonic, X-ray, tensile and impact testing; there also is equipment for acid etch work, a chemistry laboratory and a mass spectrometer. Among the more interesting products produced by the Forging & Casting Division are those of exotic metals: zirconium, titanium and beryllium alloys.

Largest hammers in the shop are two 6000-pound units, one of which is shown at right. At far right a smaller hammer forges a glowing ring into shape. In the photo on the opposite page, a block is worked.



REMOVING WATER FROM SALT

Other Processes

S. M. Parkhill

THERE are basic problems with thermal distillation processes discussed last month. Primary among these is corrosive action of sea water on metal surfaces, scale that fouls heat transfer equipment, and circulation of liquids.

Corrosive action may result from the galvanic effects between dissimilar metals in the presence of saline solutions. To minimize this, a composition of copper, zinc, and tin is used in condenser tubes. Even this is subject to electrolytic damage if other parts of the system contain iron. Several types of stainless steel, cast iron containing nickel, Monel metal and alloys of aluminum, brass or copper-nickel have been used to control expensive maintenance and replacement resulting from corrosion. Further control is gained with plastic pipe, or steel pipe lined with plastic and bituminous coatings. Some experiments have been made with cathodic protection.

Scale formation occurs during distillation processes operating above 190° F. As water evaporates, some solids ordinarily dissolved in sea water are precipitated and deposited in rock-like form on the walls of tubes carrying water. This greatly reduces the rate of heat flow through the tube into the water, not to mention general plugging. It requires periodic shutdown. Scale formation can be lessened with low temperature operation—under 150° F. Vapor compression and multistage flash evaporators have been successful in this respect.

Sludge recirculation is another method under development for calcium carbonate control. As solutions that precipitate crystals reach saturation for a particular solid and the material is ready to come out of the solution in a solid form, it will deposit itself on an already existing crystal of similar nature rather than on free surfaces, such as the heated walls of evaporation tubes.

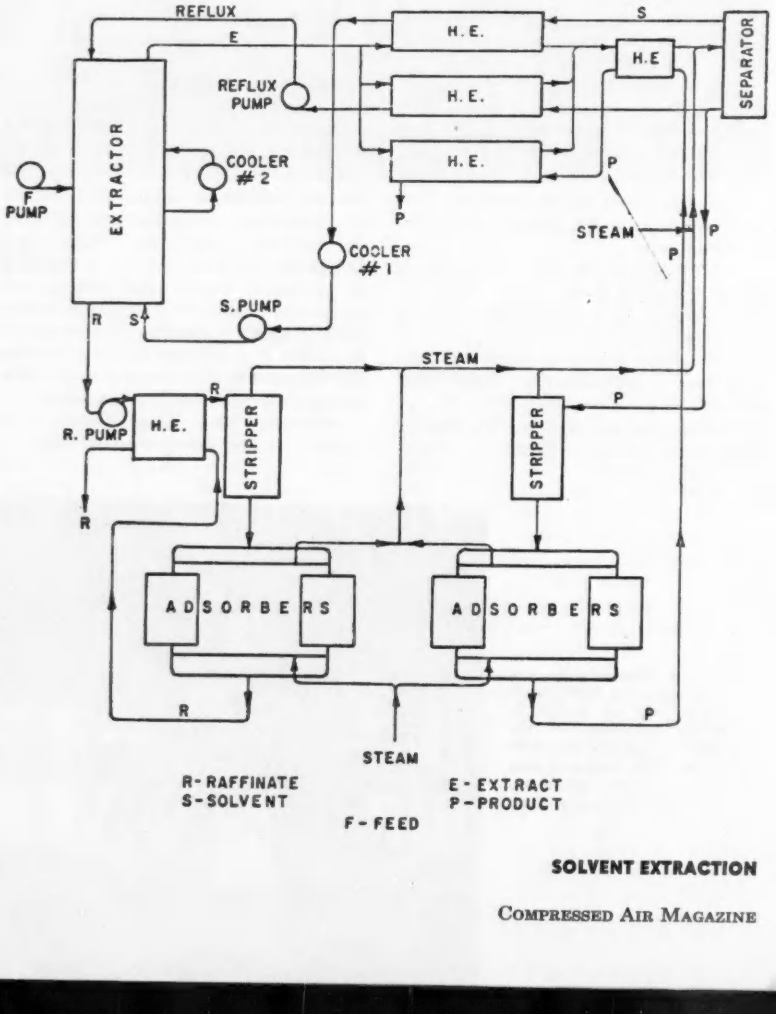
Considering these problems, it might be well to investigate processes other than thermal distillation—solvent extraction and adsorption, freezing and gas hydrate chemical systems—even though thermal distillation has the lion's share of the market today.

Extraction and Adsorption

In distillation, heat is used as an external separating agent to create a second (vapor) phase from the feed liquid. Separation is made according to the boiling points of the components in the feed mixture. However, as we have seen, use of heat as the external separating agent limits the usefulness of distillation processes.

Extraction is also a diffusional operation. A liquid solvent not completely miscible with the feed liquor is the external separating agent, rather than heat. The great difficulty in solvent extraction is due to the paucity of solvents available to act as these external agents.

Use of liquids or solid adsorbents for demineralization of saline waters has been proposed by several investigators. It permits a dual approach: (1) removal of salt from water; and, (2) removal of water from salt. The second



SOLVENT EXTRACTION

has more promise from a practical standpoint.

Solvent extraction desalination processes (sometimes referred to as liquid-liquid processes) involve mixing saline water with solvent countercurrently. This selectively extracts water at a given temperature. By increasing the temperatures of the extract, the solvent and water phases separate. The former is cooled and returned to the system, and the water phase is further treated to remove traces of dissolved solvent and produce potable water. Heart of the system is the liquid-liquid phase extraction.

Solvents must selectively dissolve appreciable quantities of water from saline solutions. They must form a separate phase with a reasonable temperature change, thus liberating water. And solubility of water in the solvent must be much greater than that of the solvent in water, otherwise the cost would be too great.

Known solvents fall into two groups: primary, secondary and tertiary amines; and compounds such as glycerol ethers and amino ethers. If low-cost solvents can be developed, the extraction system appears to be a good one.

Freezing

Freezing was used by ancient peoples in very dry cold climates. When nights were cold and frosty, salt water was run into ditches, then covered with stones or wooden planks. After partial freezing, the ice was collected and moved to other ditches to melt. Today, the process is basically the same.

The method offers the advantages of reduced scaling and corrosion. It is possible to operate at small temperature differentials. However there are some major drawbacks which make freezing less widely used than distillation. For one, the cost of removing 1 Btu of heat is greater than that for adding one. Another is that of eliminating salt water and brine which tend to cling strongly to the frozen fresh water crystals. Mechanical handling of ice is also a difficulty. Centrifuging and countercurrent washing have been applied to remove the entrained salt. The latter, either in stage operations or in continuous tower systems, is more effective than centrifuging, and a high degree of purification has been obtained. A combination of conventional freezing and centrifuging is not competitive with distillation in large-scale operations. And yet, significant developments in the field of freezing make its technology one of the most rapidly maturing in the conversion field. Emphasis is being placed on a control of crystal size.

In direct freezing, chilled sea water is sprayed into an evacuated tank. Part of the liquid vaporizes—part freezes. The vapor is removed by either mechanical compression or chemical absorption. Sometimes a combination of these methods is used. Separation of brine from the ice is done by draining, centrifuging, expression or washing. Expression—a squeezing, compressing action—requires power; the other methods listed are generally inefficient. Countercurrent washing seems most practical. A pilot plant using this direct freezing method is in operation at Wrightsville Beach. Its output is to be 15,000 gallons a day.

A project using a secondary refrigerant is under development at Cornell University by H. F. Wiegandt and Blaw-Knox Company. It uses a low-boiling, water-immiscible refrigerant in direct contact with precooled sea water. Hydrocarbon refrigerants, such as butane, appear suitable for ice production at 24° F. Flash evaporation of a refrigerant precludes handling large volumes of water vapor at low pressures. Hence poor efficiency characteristics of low pressure pumping systems are overcome. Refrigeration vapor is compressed and heat of compression is used to melt the ice after it has been freed of salt by countercurrent washing. Cost predictions based on electric-motor drives averages about $0.555 per 1000 gallons per day. With gas-engine drives for the compressors, the cost of a similar output is lowered to $0.507.

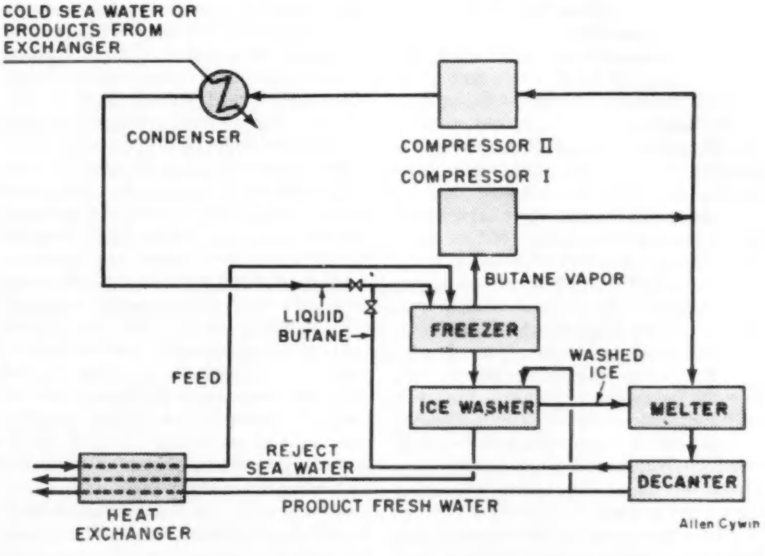
North American Aviation has designed and is building a plant using this freezer-washer-melter equipment at Oxnard, Calif. The pilot facility will produce from 15,000 to 20,000 gallons of fresh water daily. The process is in four main steps. Conventional heat exchangers are eliminated in all major phases.

The first step is precooling. Sea water temperature is lowered to near freezing by passing a hydrocarbon liquid compound, such as octane, directly through it. (The octane was previously cooled by various process streams.) Then a more volatile hydrocarbon compound (butane) enters the liquid and absorbs heat to become a gas. In this second step, ice crystals of fresh water are formed. The crystals are coated with brine, which is washed off, in the third step. The final phase is to melt the ice into fresh water by direct contact with compressed butane. The system is self-contained; no hydrocarbons are carried out with the product water.

Zone purification is yet another freezing technique. A narrow zone of water is frozen in a tube containing sea water. As the zone moves the length of the tube, formation of ice crystals tends to concentrate salt in the solution ahead of the zone, leaving a depletion of salt in the liquid behind. Cost is high, but the process is technically sound.

Gas Hydrates

A final method under consideration is a chemical freezing process. Salt water is reacted with another substance, such as propane, to form a solid hydrate. The solid phase contains no salt, but has a 5–15 mole percent hydrating agent incorporated in it. Solid hydrate is separated by melting, since the agent is relatively insoluble in liquid water. The released hydrate-producing agent is then recycled to form more solid hydrate. The principal advantage is that temperature levels at which heat must be abstracted to form the solid phase can be substantially higher than they can be in freezing processes.



DIRECT FREEZING USING BUTANE

Photo, Dept. of the Interior

Saline Water Conversion

THE OUTLOOK

PRESIDENT Kennedy, when questioned on putting a man into space, said, "If we could ever competitively at a cheap rate get fresh water from salt water, it would in the long range interest of humanity dwarf any other scientific accomplishment." This is the problem and the goal of saline water conversion in a nutshell.

If the water use-and-waste trend continues at its present rate, (and there is no indication that it will not) the U. S. will be the first technically advanced nation to suffer a shortage of fresh water, thanks to our high standard of living which depends on tremendous volumes of water, a rapidly growing population, a swift industrial expansion that not only uses water but tends to pollute it as well, and a large percentage of arid terrain. We should begin to feel the dearth by the 1970's unless something is soon done about it.

Without a question, saline water conversion seems the answer. Some believe a more careful use of water is the solution. Others believe treating organic contamination in sewage appears less formidable than removing what amounts to 7 percent more contaminants from sea water. Still others are of the opinion that the solution lies in a vast network of man-made dams and reservoirs, a recarved shore line and a complex network of aqueducts. This proposal is good, but is too long-range for the immediacy of fresh water needs. Saline water conversion, although the outlook is veiled by the wide choice of processes, the current status of equipment development, and the lack of adequate data on markets, seems to be the solution. It offers a challenge to all scientists, inventors, engineers and industries. Development of the program one day will put water desalting in the same league with such major industries as mining, steel and petroleum.

As it is with many new fields, there is a wide gap between laboratory experiments, pilot operations, demonstration plants and full-scale commercial units. The procedure set up by the Office of Saline Water for research and development begins with an evaluation of all theoretical processes. Those that seem to contain the most promise are developed and a pilot plant is built. From data gained, a demonstration plant is next designed as a production unit. It provides data on reliability, engineering, operations and economics potential.

The OSW has several pilot plants in operation. For distillation research, there is one at Harbor Island, Wrightsville Beach, N. C., and one at Battelle Memorial Institute, Columbus, Ohio. There are four electrodialysis units under test at the Bureau of Reclamation Laboratories, Denver, Colo. The freezing processes are being studied in a 15,000-gallon-per-day installation by Carrier Corporation, Syracuse, N. Y. Three solar distillation pilot plants are set up at Daytona Beach, Fla.

At present, five demonstration plants are in operation or are scheduled for completion by 1962. They are located at Freeport, Tex., (LTV multiple-effect), 1961; San Diego, Calif., (multistage flash distillation), 1961; Webster, S. D., (membrane—electrodialysis), 1961; Roswell, N. M., (forced-circulation, vapor compression distillation), 1962; and one freezing process plant on the East Coast, to be completed next year. The decision in 1958 to build these five plants ended the first phase of the program set up by the OSW. Two plants at Webster and Roswell refine brackish waters and the other three will treat sea water. The former two lie in a brackish water belt that extends from North Dakota to New Mexico.

Not until many full-scale commercial units are in operation, though, will the subject of costs be clear. Performance figures are necessarily equally vague. What is known, however, is that all the methods of desalting water have not yet been explored. Perhaps even the best ones have not been conceived. Materials and equipment need improvement. Co-operation should be achieved among government agencies, the government and industry, and among nations. And individual companies may well strike out with their own research and development programs. At present only nine are active in the field of distillation. Three are leaders in membrane electrodialysis, and four are principal developers of freezing process equipment.

It has been said of water, "it is either too bad, or there is too much, or there is too little." Pollution control has gained wide support. Dam construction is a major phase of the construction industry. Now we must turn to saline water conversion. John Milton made the point in *Paradise Lost*,

Accuse not Nature! She hath done her part;
Do thou but thine.

this & that

Two Peruvian Tunnels

Two tunnels costing \$8,400,000 will be driven under the Peruvian Andes by Cerro de Pasco Corporation so that silver, lead and zinc ore bodies can be worked. The ores can't be reached now because of underground flooding. Known as the Graton project, the two bores will be 7 miles long and 8 feet in diameter; work will begin this year and is scheduled for completion in 5 years. One tunnel will shunt hot water away from the lower levels of Casapalca mine about 67 miles east of Lima and allow miners to go down to a depth of 2400 feet below the current 930-foot working level. The mine is at about 14,000-foot elevation. The second tunnel will be a ventilation adit and will also be used for haulage. The two tunnels will be 30 to 60 feet apart. Vertical connections will link them with the mine at a point under the principal shaft of Casapalca Mine. At the other ends will be the Rimac River Valley about 60 miles east of Lima. Currently about 900 men work in the mine and the big project will lengthen its life.

★ ★ ★

Skindiving For Oil Samples

The Edmonton Aquanauts, members of a skin-diving club, are probing the muddy bottoms of several lakes in Alberta in the name of science. Lake Wadamun, Jackfish Lake and Pyramid Lake have been entered and samples returned to the surface. (The divers used a cylindrical copper section-plunger to obtain columnar samples and an ordinary plastic bucket for bulk specimens.) As a result surprising discoveries concerning the origin and formation of crude oil have been made by the Research Council of Alberta. The mud has been subjected to tests to establish the time necessary for the formation of crude oil from organic and other substances. The sediment contains minute quantities of crude oil and traces of chlorophyll derivative, a component of crude oil. Using a spectrophotometer, the green chlorophyll has been employed as a trace material to gauge the chemical age of the specimen. The green color changes directly with chemical age in a constant relation. Investigations indicate that most of the transformation of organic and other substances takes place in a shorter time than had been thought likely. Scientists believe that the transformation period may be less than 100 years—not the million-year span previously estimated.

★ ★ ★

Friendly Finny Launderers

Some fish visit their favorite laundryman as often as three times a day and spend as much time at the cleaners as in browsing for food, according to Conrad Limbaugh, an underwater naturalist and chief diving officer at Scripps Institution of Oceanography. According to "Scientific American Feature," when plagued by parasites or bacteria, many fish immediately seek out other fish or crustaceans that specialize in feeding on the offensive pests and diseased tissue. "The relationship between the cleaner and the cleaned," says Dr. Limbaugh, "is frequently so casual as to seem accidental. On the other hand, one finds in the Bahamas and other tropical waters a highly organized relationship between a small shrimp and its numerous clients. The transparent body of this tiny animal, known as the Pederson shrimp, is striped white and spotted with violet, a sort of barber pole coloration that makes it strongly visible against its natural background. The Pederson shrimp establishes its station in quiet waters where fishes congregate or frequently pass. When a fish approaches, the shrimp will whip its long antennae and sway its body back and forth. Interested fish will swim directly to the shrimp. The fish usually presents its head or gill cover for cleaning, but if it is bothered by something out of the ordinary, such as an injury near its tail, it presents itself tail first. The shrimp swims or crawls forward, climbs aboard and walks rapidly over the fish, checking irregularities, tugging at parasites with its claws and cleaning injured areas. The fish remains almost motionless during this inspection and even allows the shrimp to make minor incisions to get at subcutaneous parasites. As the shrimp approaches the gill covers, the fish opens each one in turn and allows the shrimp to enter and forage among the gills. The shrimp is even permitted to enter and leave the fish's mouth cavity. Local fishes quickly learn the location of these 'laundryman' shrimp. They line up or crowd around for their turn and often continue to wait after the shrimp has retired into its hole."

★ ★ ★

Pollution's Subtler Effects

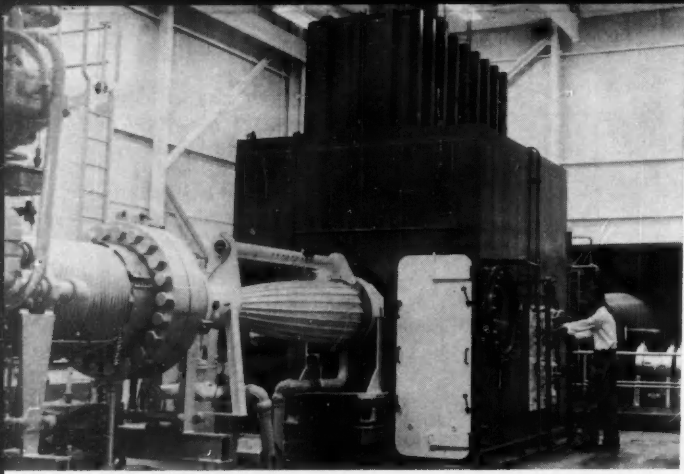
Air pollution is acquiring ramifications more subtle than dire influence on human life and well being. A preliminary summary of a study on the economic effects of air pollution in a Midwestern town is given in the 1960 annual report of the Armour Research Foundation. The Foundation is a nonprofit independent research organization associated with the Illinois Institute of Technology. Three medium-sized cities were selected for scrutiny: Uniontown, Pa.; Martins Ferry, Ohio; and Steubenville, Ohio. These communities were chosen because they varied considerably in the amounts of air pollution present. The researchers learned how much citizens in each city spent for such necessities as laundry and dry cleaning, home upkeep and repairs, and for office and business maintenance. They found a definite relationship exists between air pollution and private expenditures, and the conclusion was drawn that pollution creates hidden expenses for the average private citizen.

★ ★ ★

Easy Air Filter Tests

Most air-actuated equipment and processes require filtration of the input air. The question arises, though, "How well is the compressed air filter working?" To answer this, King Engineering Corporation has developed a practical method for determining comparative filter performance. In brief, a lubricator introduces a mist of oil into the air entering the filter. The filtered air is released from a tube into a beam of light from a projector. Against a dark background, oil mist in the cone of air leaving the tube is highly visible. The performance of the filter is then judged by comparing the size and brightness of this outlet cone with that obtained using unfiltered air taken directly from the lubricator. The company has published a bulletin showing a set-up using this testing method and several outlet-cone photos taken under controlled conditions.

EDITOR'S NOTE: At the time material was gathered for the article on the Douglas Aerophysics Laboratory (*Blowdown Testing,* March 1961) pictures and full details of the Lab's new hypersonic tunnel were not available. As a sequel, we review here some of the tunnel's features.



HYPERSONIC TUNNEL In this view of the tunnel, air enters at left, passes through the restricted throat and into the main test section in the center. Flowing around the model, the air stream then enters diffusers and is exhausted to atmosphere by air ejectors that maintain an absolute pressure of 1 to 6 psia downstream of the test section. The throat shown in this view is for Mach-6 speeds.

MORE ABOUT—

Blowdown Testing

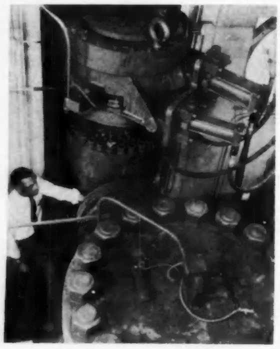
THE DOUGLAS Aerophysics Laboratory hypersonic wind tunnel is an intermittent blown-down-to-atmosphere, free-jet facility. It is the first major hypersonic tunnel in industry, and is designed to test models of aircraft, missiles and space vehicles at speeds of 3000 to 6000 mph (that is, in the hypersonic range of Mach 5 to Mach 10) at temperatures to 2250° F.

Air for the tunnel is stored at 3500 psia in a pair of 250-cubic-foot capacity tanks. At test initiation, it is discharged through an 8-inch-diameter, quick-opening (0.5 second) valve. In the circuit is a 10 million-Btu pebble-bed heater that can raise the temperature of the air stream to a maximum of 2500° F. The heater enables a degree of environmental testing and also prevents the air from liquefying as it passes through the throat.

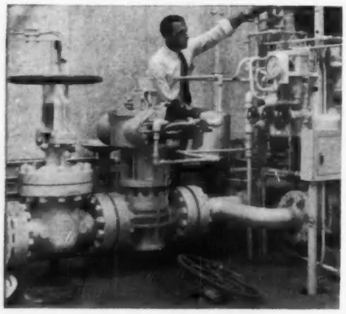
Although the tunnel is termed a blowdown-to-atmosphere unit, it actually blows through to an absolute pressure of 1 to 6 psia as far as flows through the test section are concerned. The reduced pressure in the tunnel is provided by air ejectors. These are supplied with compressed air at a pressure of 525 psia from tanks serving the Lab's supersonic tunnel.

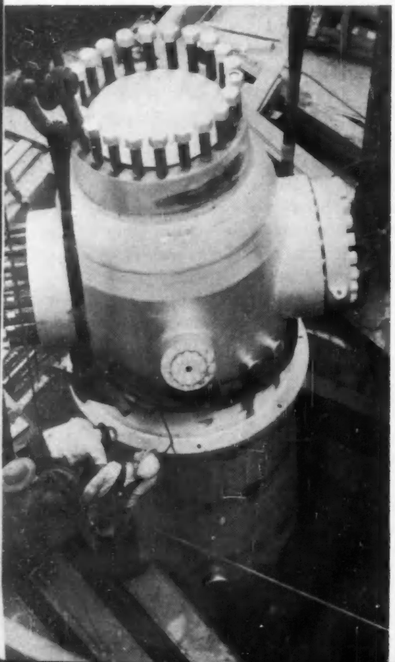
The tunnel has provision for holding test models out of the air stream until stable conditions are attained. Then the model is moved into the 27-inch-diameter free jet and programmed through specific flight maneuvers during which measurements of force, pressure, temperature, heat transfer and dynamic characteristics are taken. The model can be rotated ±30 degrees in angle of attack, and rolled ±200 degrees on the tunnel centerline. The average tunnel run lasts about 30 seconds, but if required, can be extended to 3 minutes. After about a half-hour regeneration period for the heater and recharging of the air tanks, another test can be initiated.

Information from the tests is collected in digital form and is processed through automatic computers and plotters. Final tabulated and plotted data are available within 5 minutes of test completion. During an average run, about 1000 separate bits of information are collected for later study and evaluation by design engineers.



VALVING At the lower right is shown the remotely controlled valves that vent 3500 psia air to the main blowdown circuit. Part of the air goes to the pebble-bed heater, the remainder directly to a thermal mixing valve. The split stream rejoins in the mixer and there is adjusted to the proper temperature for the test work and Mach number involved. In the picture at the right, the thermal mixer is shown in the foreground, the main quick-opening valve in the background.





HUSKY HEATER The pebble-bed heater for the hypersonic tunnel is shown at left during installation. The unit weighs 120 tons. Heavy steel construction is necessary to withstand 3500-psia pressure. Having a maximum heat-input rate of 10 million Btu per hour, the massive vessel is charged with 24,100 pounds of alumina pebbles about 3/8 inch in diameter. It is fired with natural gas, an LPG system being installed to backup the interruptible gas supply. In operation, pebbles serve as a heat transfer medium, being warmed to high temperature prior to passing air directly over them.

editorial

Defense

THE DEFENSE posture of the United States is an item of extreme interest throughout the western world. An article in this month's issue describes the burrowing underground of our missile system. We picked the Atlas bases now nearing completion as indicative of the vast construction effort being put forth to harden or render more defensible our missile launching stations. The six Atlas bases described will add a potent deterrent punch to that defense, and when coupled with the Titan and Minuteman bases also underway should do a great deal to maintain the much sought after balance of power. There are those who believe that that balance is slightly tipped in our favor because of the five fleet ballistic missile submarines now cruising on patrol, each in a state of readiness to launch its covey of sixteen Polaris missiles. No sneak attack can effectively reach the subs.

A glance at the pictures accompanying the article on the Atlas bases reveals the vast amount of compressed air equipment used in putting down the silos. Cumulatively the job for the six Atlas bases called for some 12,000 feet of shaft sinking, probably more than half of which was in rock. The top third of each silo is more than 70 feet in diameter as excavated, and the bottom two thirds, just under 60 feet. Modern single- and double-boom crawler-mounted drifters did a lot of the work, and hand-held Jackhamers helped out too. Concrete vibrators powered by compressed air helped in placing the great quantities of reinforced concrete, and pneumatic tools played a big part in erecting what amounts to a 17-story structural steel building inside of each silo. More than 13,000 high-strength bolts hold the giant steel frames together.

The role of compressed air power in this phase of defense construction is much amplified when similar uses for all of the Titan and Minuteman silos are considered. The uses for compressed air and gas equipment can be multiplied again if one traces back through the missile system. The supply of liquid oxygen for the fuel tanks of the "birds" is one example, as are all phases of their manufacture, handling and installation. As described in the section on the missile itself, the Atlas has no internal members in its fuel tanks, but is instead pressurized to maintain its shape and rigidity. Out-sized pneumatic tires cushion the rough ride from factory to silo for the missiles, and air hoists handle lines for the flammable liquid fuels.

In months to come an article describing the use of high-pressure air to launch the potent Polaris from its submerged base will appear in these pages. Polaris is an incredibly complex weapons system. The difficulties of getting a true launch of a missile from shore-based stations have been well described in countless newspaper and magazine articles. The problems are compounded manifold when the launch takes place from a platform moving in only one plane. Submarines have a three dimensional movement, and when the problems of launching from underwater are added, the job looks impossible. Yet Polaris has proved its reliability time and time again, and a good part of its performance is based on the compressed air that spews it into the air where its main engines can be ignited. The submarine itself lives only because of its compressed air supply both for its crew and for blowing its ballast so that it may surface.

Besides these immediate and important uses directly connected with the defense machine, there are a variety of other uses of compressed air in the defense industry stretching back a long way on the path of manufactured goods. Air is vital in such beginnings as the winning of uranium from the earth and in its subsequent concentration. But there is no need to belabor the point; air power is deeply interwoven into the industrial might that is, after all, our best defense in wars both hot and cold.

Preventive Maintenance For Rock Drills

I. The New Drill

MAINTENANCE of rock drills should begin when the drill is put into service. Even the experienced driller should read the service manual. Though he may know general rules for handling a drill, instructions for special machines may mean the difference between long-time smooth operation or an early breakdown. Reputable manufacturers continually make minor alterations in drills, incorporating into current models changes in metallurgy and even design that are indicated by the service reports flowing into their design laboratories. And, when new models are brought out, the manufacturer has put into them a great deal of time and thought aimed at offering a drill that will do more, faster and more efficiently than old models. His suggestions for the care and feeding of his new or improved product should be followed from the beginning, not after the first case of trouble arises.

Before Start-up

Careful attention should be paid to recommended lubrication procedures, especially at start-up. This series will give a long hard look at lubrication practice because it is the single most important key to success or failure in rock drill maintenance. There is a lube tag attached to almost every new machine shipped by major manufacturers; it lists the type of oil and required service intervals. Paying attention to the instructions on the tag will net better service and better performance. If the drill is the first of its type on the job, the tag should be filed with the service literature for the drill, making sure that the master mechanic and drill doctors are aware of any changes in practice that are indicated.

New drills should be unpacked and inspected in clean surroundings. Before being released for service, any protective plugs or caps the maker has placed in exhaust and inlet ports should be removed. The serial number of the drill should be noted on a permanent maintenance record card and all subsequent maintenance operations should also be listed there. Not only will such record cards permit the tracing of any particular problem, it will help to indicate bad practices by drillers and will aid in determining when an old, outmoded drill should be replaced by more economical new equipment.

When the new drill is assigned to work, its operators should be briefed by the manufacturer's service man and/or the shifter, walking boss or other supervisor, on any indicated changes in operation so that all of the performance built into the drill will be obtained.

Compressor Requirements

The most perfectly maintained rock drill won't work correctly, of course, unless air is available at the right pressure and volume at the drill. The instruction book should be consulted to be sure a suitable compressor is being used. Several factors influencing compressor performance should also be investigated: running speed, condition of valves, pipe sizes, leakage in lines, hose length, altitude, and whether the drills will be working intermittently or continuously. Once it is decided that the compressor is suitable, other conditions must be met pertaining specifically to rock drills.

Pressure and Volume

Low pressure at a drill is costly and wasteful. The absence of a few pounds is far more significant than the small number might seem. Pressures of 90 to 100 psig are recommended for construction tools, hand-held rock drills, and drifters. Remember that these are pressures *at the drill*. A certain amount of line drop between compressor and point of use will always exist and must be expected. If transmission lines are large enough and in good condition, this drop will be less than 10 percent.

Pressures below 80 psig have an immediate, drastic effect on drilling speed. Performance falls off rapidly, and at pressures below 60 psig, penetration is so poor that little useful work can be done.

An insufficient volume of air at the drill will also, of course, prevent the machine from working effectively. Information giving the amount of air needed to operate a tool is available from the drill manufacturer. These recommendations should be followed. Be sure the air is actually being delivered: the rated capacity of the compressor does not mean that it can deliver its rating through pipes and hoses not in first-class condition.

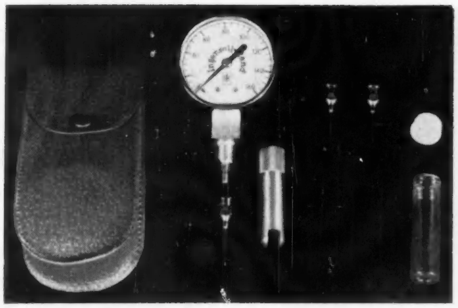
Air Hose

Only use hose designed expressly for rock drill service. It will have an outer cover that resists abrasion, and an inner tube that is oil resistant. A good hose should easily be able to withstand normal heat of compression. It should be at least *one size larger* than the pipe thread on the drill's air inlet. For safety, it should have a burst factor of 4 to 1 in relation to working pressure.

Fittings on the line must be inspected regularly for tightness and general condition. Shabby fittings are leeches that reduce efficiency in two ways. First, the resulting air leaks cause a reduction in pressure and bleed away volume; second, shreds of rubber or fabric that break loose are often swept along the line to the drill or the air strainer where they further cut performance. Air lost through poor connections can amount to 10 or 20 percent of the total compressed—a very important 10 or 20 percent.

If hose ends become damaged by clamps, the line should be cleanly severed behind the fitting and a sound joint made. Attention to hose length is

Editor's note: This begins a new series of planned preventive maintenance articles, dealing this time with rock drills. Drill equipment is precision-made with narrow tolerances and superior finishes on many working parts, yet there are few other types of machinery asked to work in worse conditions. To obtain top production from rock drills, and the most economic operation, correct maintenance practices must be followed.



PRESSURE CHECK For best performance, a rock drill should have a minimum of 90-psig air available. The measurement has to be made at the drill, when it is working—not at the compressor. The needle gauge kit shown in these views does the job without harming hose.

important. Lines with fixed connections should have a slight surplus or slack to reduce the possibility of the coupling shank cutting through the tube into the carcass, and to allow for natural hose contraction under pressure.

A list of hints for handling hose would include: hang it on reels or racks instead of sharp hooks that will tend to deform and crack the rubber; shut off hose at a manifold instead of at the nozzle for this forces the line to withstand high pressure unnecessarily; don't subject hose to more than its rated working pressure; and avoid twisting flexible hose because this stresses the reinforcing members and weakens the line.

Water Lines

Most suggestions for the care of air lines apply to water hose too. For most effective hole cleaning, water should be maintained at about 10 psi less than air pressure, and *never* fall below 40 psi.

Drilling Hints

If good drill maintenance practice starts before the drill is put to work, its next step must surely be proper care during operation. The handling of the drill is extremely important to its life and efficiency. Rock drills are tough—they are built to hammer out holes in hard rock. They aren't built to stand up forever under abuse such as dropping them, letting them soak in mud puddles or standing them on their front head on a sandy gritty floor. When not in use, set them carefully aside where other equipment won't bang into them and where they will be as dry as conditions permit. Protect the drill steel opening so that sand and grit don't enter.

When ready to drill, check air line oilers, making sure enough lubricant is at hand to complete the round or the shift. Blow out the air line if there is any possibility that sand, grit or moisture could have entered it. Then put the drill to work.

In collaring a hole, hold the drill firmly against the face and use a steel short enough for comfortable handling. Open the throttle gradually and begin the hole at no more than half throttle. Wait until the bit is 2 inches into rock before going to full throttle. If drilling at an angle, keep the tool at right angles to the face until the hole is fully collared, then reposition it.

With hand-held machines, the best drilling is obtained when the drill is held by both hands with a firm, steady pressure. Too little pressure will cause the tool to bounce and may crack carbide inserts. Too much will slow down the machine and may cause a stuck steel. Drill, drill steel and hole must be aligned with each other at all times; this means using both hands. When a "drill jockey" throws his leg over the drill handle he places excess pressure on one side, forces the machine out of alignment, and consequently may increase chuck wear. He also changes the direction of the hole. When he places the other leg on the drill, he alters the direction of the hole again. The practice is unsafe, harms the machine and makes the hole difficult to load.

Once in operation, be sure to keep the hole clean either by blowing it out in the case of dry drilling, or by using plenty of water with wet drills. A drill churning its own cuttings slows down. A stuck steel often results.

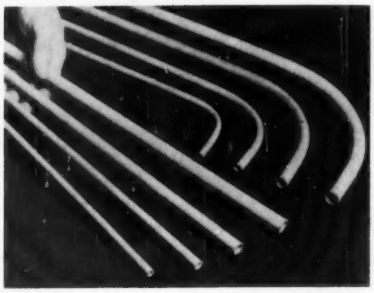
When work is done in moist formations, cuttings tend to pack in behind the bit and form a "mud collar." The cuttings packing against the hole wall can eventually cause a stuck steel, so keep the hole clean. Also check to see that the steel is open at both ends and bit passages are clear. Obstructions in the steel or bit interfere with blowing capacity. In short, keep the hole blown free and the bit working against fresh rock. It will pay off in more feet of hole per shift, and in less wear and tear on men and machines.

DO AND DON'T Right is right and left is wrong in these pictures of Jackhamers at work. Throwing a leg over the drill not only can throw the hole out of line and make it hard to load, but it can cause misalignment of the drill. As indicated in text, the practice is unsafe and may even slow drilling speed or cause stuck steels.

Industrial Notes

IN *Drilling Rigs for Every Type of Rock Job,* Ingersoll-Rand Company shows special rock drilling rigs for construction, mining, tunneling and submarine work. The 20-page booklet, Form 4215, shows many on-the-job photographs of special rigs engineered to meet exact requirements of each job. It is designed to show how contractors and mine operators can create special drilling rigs to meet their own particular problems. *Ingersoll-Rand Company,* 11 Broadway, New York 4, N. Y.

TWO GRADES of postformable Micarta tubing are available from Westinghouse Electric Corporation. One (HY-370) is paper-based; the other (HY-371), cloth-based. Both are reported to have sufficient thermoplasticity to allow the tubing to soften when heated for 5 minutes in a thermal environment of 135° to 150° C. After it is softened, the tubing can then be given a permanent configuration. At room temperature and



below, the postformed tubing displays the rigidity and other physical and electrical properties of standard thermoset tubing and meets NEMA LE standards of chemical resistance and stability. Compressive strength of the tubing is 18,500 psi for the paper-based grade and 23,300 psig for the HY-371. Water absorption is 2.1 percent and 0.8 percent; short-time dielectric strength is 700 v per mil and 341 v per mil, respectively. Internal diameters range from $^1/_8$ through 1 inch, wall thicknesses are from $^1/_{32}$ through $^3/_{16}$ inch, and maximum length is 46 inches. *Westinghouse Electric Corporation,* Micarta Division, Hampton, S. C.

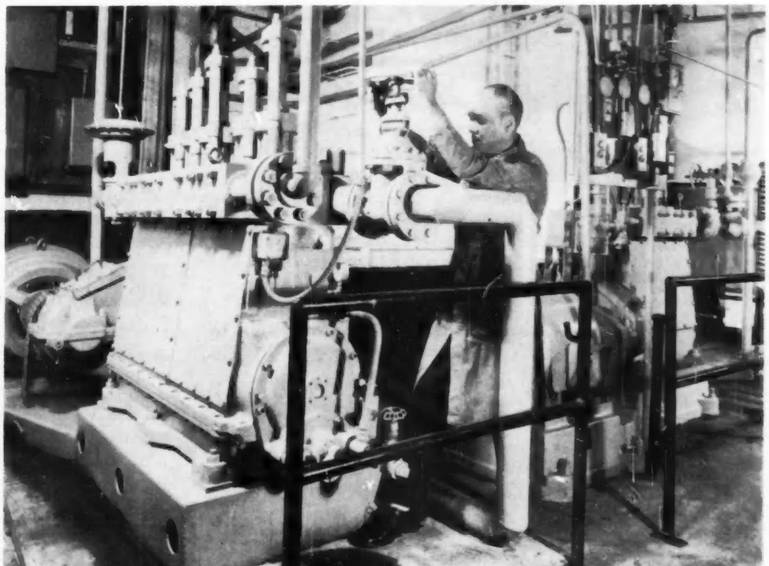
GASKET users will find that booklet AD-190, "Gasket Materials," provides a wealth of material. Detailed information concerning the various styles of gasket materials available is presented. *Garlock Inc.,* Palmyra, N. Y.

TYPE 20AS precision pressure regulator is reportedly accurate at pressures below 1 psig. This is true because the pilot valve movement is extremely small. The regulator reduces line pressures of 0 to 150 psig to secondary pressures of 0 to 60 psig, and it is used over a temperature range of 32° to 160° F. It is made for $^1/_4$-inch pipe, and finds applications in such areas as air gauging, laboratories, and precision pilot air regulation. The 20AS regulator provides accurate pressure control to the maximum air flow recommended for $^1/_4$-inch

---

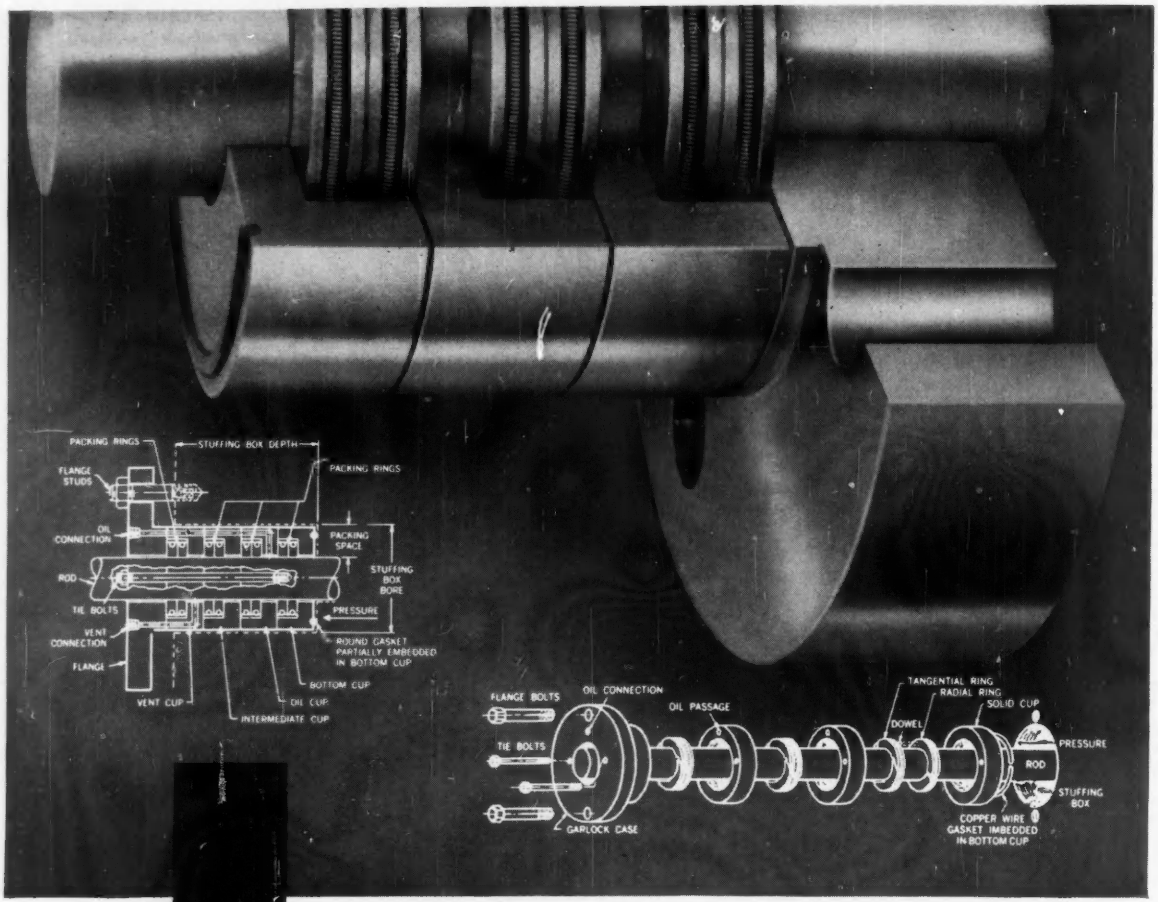
VULCANIZED rubber molding and extrusion presses always place stringent requirements on hydraulic pumps. Hydraulic pressure must be maintained accurately and at a steady, high level so mold cavities will fill out consistently, thereby keeping rejects to a minimum. For example, at Schacht Rubber Manufacturing Company, Inc., Huntington, Ind., hydraulic presses are operated three shifts a day, turning out rubber houseware and hardware items as well as mechanical rubber goods. Here hydraulic pump dependability and accurate pressure maintenance is essential to plant efficiency and to the maintenance of tight delivery schedules.

To meet these requirements, two high-pressure reciprocating pumps are used. These deliver a total of 170 gallons of hydraulic fluid per minute. (The fluid is made up of water and soluble oil.) A valve chest connects pump output to a deadweight accumulator that furnishes pressure at 1200 psig. Any deviation from the desired line pressure actuates a controller to regulate pump output. Thus is assured steady, even hydraulic pressure to the rubber molding and extrusion presses. The pumps, manufactured by Aldrich Pump Company, a



subsidiary of Ingersoll-Rand Company, are called Quintuplex and Triplex.

Only routine maintenance of the pumps is required: an oil check every few months and an occasional packing replacement. As a result, Schacht Rubber is able to provide fast customer service based on speed and dependability.



GARLOCK METAL PACKING

proved superior for air and gas compressors

For packings that offer a tight, leak-proof seal . . . for packings that keep compressor rods leak-free for years . . . for packings that need little or no attention after installation . . . specify engineered Garlock Metal Packings.

Packing rings super-finished to a flatness measurable in light bands. Only Garlock gives you such precision finishing—such a positive seal between ring and groove. And, thanks to an exclusive Garlock manufacturing technique, this super-finish is yours without additional cost.

A style and material for every application. Quality-made to exact specifications, Garlock Metal Packing Rings are available in Graphitic Cast Iron, Bronze, Carbon, Babbitt, Amberite laminated phenolics and Teflon*. Whichever you require, you can be sure of the finest metal packing available.

These rugged standards must be met by every Metal Packing Set leaving the Garlock factory:

1. Gas-tight seal between rings and compressor rod.
2. Gas-tight seal between rings and packing groove.
3. Packing must not be affected by operating conditions.
4. Operating conditions must not be affected by packing.
5. Packings must have no adverse effect on compressor rod.

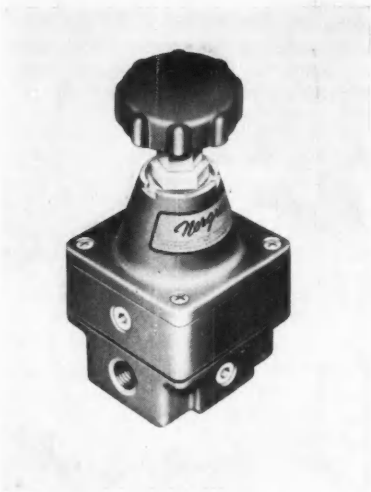
Assure yourself proper application by calling your Garlock representative at the nearest of 26 Garlock sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-166, Garlock Inc., Palmyra, N.Y.

Canadian Div.: Garlock of Canada Ltd. **Plastics Div.:** United States Gasket Company. **Order from the complete line** of quality Garlock products . . . Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Stock and Parts.

*DuPont Trademark for TFE Fluorocarbon Resin

GARLOCK

pipe. This is about twice the air flow range over which most precision units of this type will operate accurately, according to a company report. The regulator operates without hunt, hum and chatter. It has built-in relief, and fea-



tures exact repeatability and freedom from drift over short or long periods. *C. A. Norgren Company,* 3400 S. Elati Street, Englewood, Colo.

ALNICO VIII is a permanent magnet introduced by Crucible Steel Company. It has more than twice as much resistance to demagnetization as the company's ALNICO V, and is substantially higher in both coercive force and maximum energy product than either its ALNICO VI or VII. In the past, there were many applications for permanent magnets where severe temperatures and other environmental conditions made their use impractical. Now ALNICO VIII, coupled with excellent temperature stability, allows practical design. Where the designer needs high resistance to demagnetization, space saving and low unit energy cost, ALNICO VIII is uniquely adaptable. For example, it can be used to good advantage in flat-type speaker structures, permanent magnet cores for meters, magnetic separators, and focusing of electron beams. A tentative data sheet for ALNICO VIII is available on request. *Crucible Steel Company of America,* Department IS, P. O. Box 88, Pittsburgh 30, Pa.

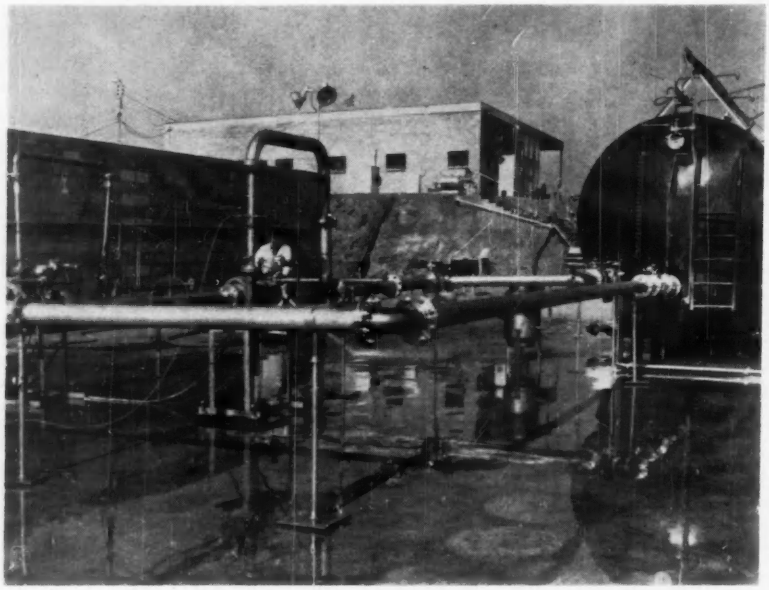
A VALVE that automatically and continuously eliminates water and oil condensation from compressed air lines without causing pressure drop has been perfected by Barger Manufacturing. Called the Moisture Minder, it can be readily attached to existing pneumatic systems without cutting lines. Installation is inexpensive and is performed in a matter of minutes. It is further said that the valve rarely needs attention or servicing. It will not balance off and bleed air from the system. The valve takes advantage of the pressure in the system in removing condensation. In most installations, no air is wasted. The unit is just under 6 inches long, is $1^1/_4$ inches in diameter and is threaded to fit standard $^1/_4$-inch pipe. In addition to serving the compressed air industry, the product may see use in air braking systems of trucks and buses. In typical installations, though, the Moisture Minder is attached to existing filter bowls, drop legs, aftercoolers and compressor points. *Barger Manufacturing Company,* 204 Foshay Tower, Minneapolis 2, Minn.

PRESSURE-VACUUM control, Type H41, is small and sensitive. It is offered for use on a wide variety of applications, such as sterilizers, centrifuges, welding equipment, panel boards and process control equipment. Designed without an enclosure for direct incorporation into equipment, the H41 combines high sensitivity, small size and low cost. Several adjustable ranges are available within limits of 30 inches Hg vacuum and 500-psig pressure, with on-off differentials from 1.5 inches Hg $\pm$ $^1/_2$ inch, to 10-psig pressure, $\pm$ 3 psig. Mounting bracket and bellows housing are brass. Approximate weight is 13 ounces.

Switch actions include normally open, closed and double throw, and are suitable for ambients to 180° F. Standard electrical ratings are 15 to 20 amperes, 115/220-v a. c. *United Electric Controls Company,* Department N, 85 School Street, Watertown 72, Mass.

WITH the advent of storable propellants, new problems have arisen in compatibility, toxicity, functional operation and general materials handling. Wyle Laboratories has recently completed a storable propellant test facility in a remote 300-acre site in Norco, Calif. This storable propellant operation consists of two separate test systems: one for nitrogen tetroxide; the other, for aerozine-50. Its purpose is to measure the functional operation and compatibility of storable propellant systems and components under full-flow and operating pressures using actual media.

Jamesbury Double-Seal ball valves



were utilized in four specific research projects currently being carried out: (1) determining flow characteristics with aerozine-50 (illustrated); (2) performing leakage and compatibility tests; (3) determining NPSH characteristics of canned pumps; and (4) in blending UDMH and hydrazine in a mechanical mixing chamber to obtain aerozine-50, a new fuel for missile use. The valves, the manufacturer reports, are qualified for this carefully supervised and controlled work because of their special design features. A patented lip seal, for example, provides compensation for temperature, pressure and wear and can offer continuous leakproof performance. Valves are of sturdy, shock-resistant unit body construction. Moreover, the valve stem can be entirely removed from the valve in the fully closed position without leakage through the stem port. Full details about the valves, including materials, styles, sizes and prices, are available from the company. *Jamesbury Corporation,* New Street, Worcester, Mass.

ADAMS TR filter removes condensed moisture and oil, and pipe scale from compressed air lines in a 2-stage cleaning cycle. Bulletin 118 gives applications, sizes, specifications and complete prices. *R. P. Adams Company, Inc.,* 309 E. Park Drive, Buffalo 17, N. Y.

PORTABLE railroad car vibrators that combine light weight with heavy impacts are identified as KO-LSRR. These air-powered units operate at 60-psig pressure to empty hopper cars by delivering more than 1700 vibrations per minute. Although the vibrator weighs less than 70 pounds, it can create a vibratory force of more than 1000 pounds, according to the manufacturer, and will operate on as little as 30-psig pressure. The 1-piece unit is designed to fit a standard railroad hopper car bracket. It can be lifted

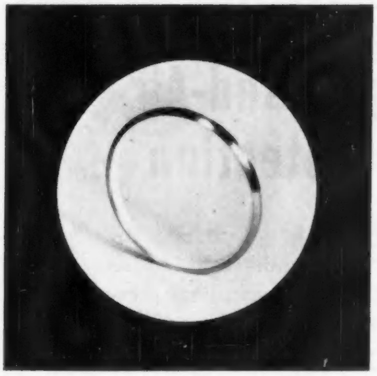
from the bracket mounting and moved without loosening or tightening bolts, clamps or other attaching devices. A built-in handle facilitates removal and carrying. The body houses a piston which may be lubricated automatically by oil fed into the air stream. Both intensity and frequency of vibration are regulated by adjusting the air supply. *The Cleveland Vibrator Company,* 2828 Clinton Avenue, Cleveland 13, Ohio.

PUBLICATION 3100-PRD-269 describes a line of motor controls suitable for full-voltage operation of synchronous motors rated 600 v and below. They feature front accessibility, 10-gauge steel enclosures, polarized field frequency control, a heavy-duty air-break contactor and are built to NEMA, Class A, Type I specifications. Optional control equipment includes weatherproof construc-

tion, custom-relaying, 110-v control circuits, disconnect means and special unloader interlocking. The publication shows dimensions and weights. *Electric Machinery Manufacturing Company*, Minneapolis 13, Minn.

CORROSION resistance of Colmonoy nickel alloys is the subject of Technical Data Sheet No. T-1. The literature lists the corrosive media to which Colmonoy nickel alloys are generally resistant and discusses corrosion resistance in broad terms. A bar chart that is included plots corrosion resistance of Colmonoy No. 6 versus 18-8 stainless steel in sodium hydroxide (50 percent at 150° F), sulphuric acid (10 percent at 220° F), nitric acid (65 percent at 70° F) and acetic acid (glacial, boiling). *Wall Colmonoy Corporation*, 19345 John R Street, Detroit 3, Mich.

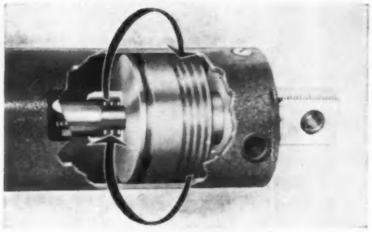
TWO-STAGE static seals, each of which has a high yield-strength stainless steel V-ring seal preceded by a Teflon seal, are available from Pall Corporation. The composite unit is designed to operate at temperatures from −65° to 600° F and under pressures to 10,000 psig. The outer ring, made of Armco 17-4PH stainless, maintains the seal under these



extreme temperatures and pressures. The Teflon primary seal, permanently joined to the metal component, provides a soft seat for leaktight sealing. The units are reusable. They are reportedly highly resistant to corrosion and compatible with nearly all fluids. Use of Teflon eliminates the need for cure dates, simplifying service and stock controls. *Pall Corporation*, 30 Sea Cliff Avenue, Glen Cove, N. Y.

ROLOTORK cast steel lubricated plug valves are said to be the only lube valves marketed that utilize a ball-bearing system to handle high-pressure line thrust on the plug. A 2-color, 16-page brochure available from Walworth tells the complete story of "How Walworth puts the roll in Rolotork." The booklet explains in detail and with unusual cutaway illustrations, exactly how Rolotork works. It also shows how the company's Unitized Gearing, coupled with Rolotork, provides users with an easily installed, operated and maintained lubricated plug valve. Valve selection is simplified by tabular listings of sizes and ratings for all available valves. *Walworth Company*, 750 Third Avenue, New York 17, N. Y.

ADJUSTING stock Modernair cylinder stroke lengths to exact fractional-inch requirements is possible with Adjust-O-Stroke. It uses a series of $^{1}/_{16}$-inch-thick spacing washers to position the piston on the piston rod. Cylinders are manufactured in stock stroke lengths in increments of 1 inch. If a user requires a



fractional-inch stroke length, say 10$^5/_8$ inch, he orders an 11-inch stock length. Then by removing six front spacing washers and adding a corresponding number of rear spacing washers, the stroke length is reduced to 10$^5/_8$ inches without disturbing mounting dimensions. Adjust-O-Stroke is offered on Modernair Economair Series R, Provenair Series M and VIH (valve-in-head) cylinders, and on the Modernair power machine control unit. Literature and further data may be obtained directly from the corporation. *Modernair Corporation,* 400 Preda Street, San Leandro, Calif.

Books . . .

Engineering Management and Administration (published by McGraw-Hill Book Company, 327 W. Forty-First Street, New York 36, N. Y.) is essentially a how-to reference book describing "how to run an engineering department in the modern industrial plant." Designed to supply ready solutions to the administrative problems that arise in the engineering departments of firms of all sizes, the book points out that these departments are often headed by men who are skilled engineers but who are unskilled in administrative matters. The author, Val Cronstedt, advocates removal of all administrative duties from the technical personnel and describes the administrator's role and responsibilities both to general management and to the engineering department. He presents a number of tools used—procedures for making engineering changes and administering budgets, for example—and develops compensation plans. Samples of policies are introduced, as well as procedures and practices that are designed to be used as guides in the preparation of a company's own operating manuals.

Among the many topics covered are traditional engineering management structures; responsibilities of the administrator; the engineering work order; responsibility and authority of the development engineer; design department duties and responsibilities; changes in engineering design; engineering records; and experimental shops. There is also considerable material on budgets and financial administration; compensation administration; engineering proposals; patent policy; technical publications; safeguarding industrial secrets; and engineering numbering systems.

Author Cronstedt is a consulting engineer with wide experience in engineering administration, having done extensive work in this field not only in the U. S., but in Sweden, the United Kingdom and Canada as well. He was chief engineer of the company now known as the Lycoming Division, Williamsport, Pa., of AVCO. He also served as executive engineer of Pratt & Whitney Aircraft Division of United Aircraft Corporation, East Hartford, Conn. For the past 10 years, he has devoted his time largely to consulting work. He is a member of the ASME and an associate fellow of the Institute of the Aerospace Sciences. 350 pages. Cost, $8.50.

Pipe Friction Manual (published by Hydraulic Institute, 122 E. Forty-Second Street, New York 17, N. Y.) contains material that is a rearrangement and extension of the pipe friction data contained in the previous edition and in an earlier publication entitled *Tentative Standards of the Hydraulic Institute—Pipe Friction.* These data are based on the latest information available.

The form of the manual follows a pattern developed as the result of numerous suggestions from users of the earlier publication. It features a section demonstrating the mathematical calculations used in the construction of later charts. This is supplemented by complete tables of friction loss for water in feet per 100 feet of pipe. Wrought iron, steel and cast iron pipe sizes from $^1/_8$ inch nominal to 84 inches i.d. are covered. There are tables of resistance coefficients for valves and fittings, 90-degree bends, diffusers and others. The tables of resistance coefficients for valves and fittings include the latest available experimental data and show the values in more detail with respect to size and type than has heretofore been published.

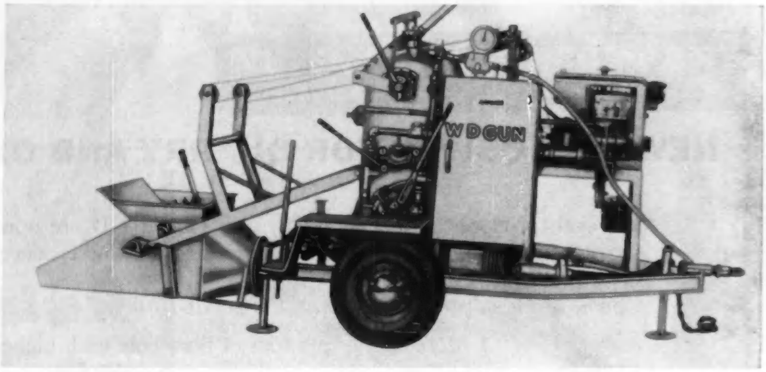
Full-page charts showing the friction loss for the incompressible flow of viscous

"There's the escape velocity we need—Smith at quitting time!"

fluids for pipe sizes from $^1/_2$ inch through 12 inches have been redrawn for greater clarity. Also included are three fold-out charts of friction factors with related data to permit the calculation of the friction loss for any liquid or gas in any size or shape conduit.

Wtih the combination of formuli, friction loss moduli, friction factor charts, roughness factor charts, viscosity tables and associated information, the *Pipe Friction Manual* is probably one of the most complete and workable treatise on the subject. 90 pages. Cost: $2, domestic; $2.40, foreign.

Flow Meter Engineering Handbook (published by Minneapolis-Honeywell Regulator Company, Brown Instruments Division, Mail Station 0280, Wayne & Windrim Avenues, Philadelphia 44, Pa.) is now published in its third edition. It has basic flow calculations rearranged for easy reference and includes primary measuring devices other than orifice plates. Author of the third edition is Charles F. Cusick, special engineering supervisor for Brown Instruments. In his 33 years with Honeywell, Cusick has contributed a number of articles about flow meters to technical publications. The book, which includes schematic diagrams, graphs, charts, tables and other data, contains separate chapters on steam, liquid and gas flow calculations, each with all data necessary to calculate or check an orifice plate installation. Three solutions to a flow problem are outlined in each chapter: an approximation check; a nominal orifice bore calculation; and a precise orifice bore calculation. The handbook also deals with selection of primary flow elements and recommended locations. It contains a chapter on coefficients for orifice plates as well as a summary of equations, nomenclature and conversion factors. Superheated steam factor tables have been expanded to include pressures to 3000 psig in high-pressure steam flow calculations. Nomenclature is approved by major instrument manufacturers and, where applicable, agrees with ASME and AGA fluid meter reports. 170 pages. Cost, $7.50.



WET OR DRY is the way the manufacturer describes this latest entry into the concrete gunning field, at least when asked to be brief. It is the first fully portable gun capable of both wet or dry gunning and pressure grouting, according to Airplaco's president. The operator can change from one method to another instantly. It is easy to see, then, that the WD Gun enables the contractor to select the method to suit the job. Featured is a Roto-Rol Mixer in the top pressure vessel to assure continuous operation. Augermatic Feed provides positive flow control with a continuous feed from a single outlet for smooth, uninterrupted movement of material. A Skip Loader screens sand and cement into separate compartments and is operated with simple foot-pedal control. A built-in water meter with variable feed control and a 15-inch fill door with a self-cleaning and sealing slide valve are additional features. Production rates for wet gunning are reported to be 4 cubic yards per hour with 250 cfm compressed air flow, $1^1/_2$-inch material hose; 6 cubic yards per hour with 315 cfm, $1^3/_4$-inch material hose; and 8 cubic yards per hour with 365 cfm of air, and a 2-inch line. For dry gunning, capacities are 4 cubic yards per hour with 250 cfm of air, $1^1/_4$-inch hose; $5^1/_2$ cubic yards per hour with 315 cfm of air and $1^1/_2$-inch hose; 7 cubic yards per hour with 365 cfm air flow, 1[illegible]/8-inch hose; and 8 cubic yards per hour with 500 or 600 cfm of air and $1^3/_4$-inch material hose. Free literature is available. *Air Placement Equipment Company*, 1012A W. Twenty-Fifth Street, Kansas City 8, Mo.

Index to Advertisers

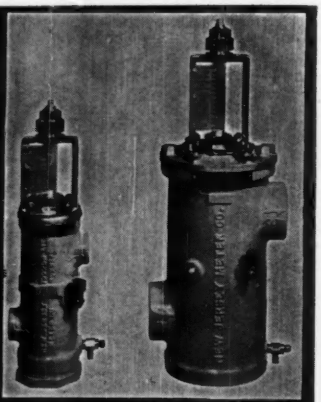
TOOL-OM-ETERS
DRILL-OM-ETERS

The Pulsation Compensated

AIR METERS

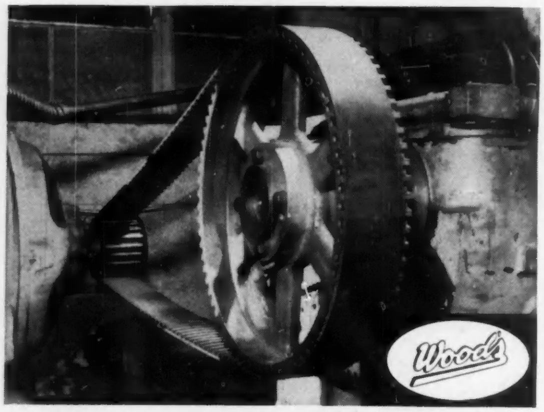
5 Ranges Covering from 4 to 450 CFM

- SIMPLE AND PRACTICAL OPERATION
- RELIABLE AND DURABLE
- PORTABLE FOR FIELD TESTING
- ACCURACY ±1%



New Jersey Air Meters measure the air consumption of any pneumatic tool, drill, motor, sand blast, or other pneumatic device or process. Air consumption is the "pulse" of the condition of air equipment. With New Jersey Air Meters you can select the most suitable equipment for your particular service, maintain this equipment in effective working condition and eliminate the "air-eaters" when they have become obsolete. KEEP YOUR PRESSURE UP AND YOUR AIR COST DOWN WITH SIMPLE, RELIABLE, PORTABLE, ACCURATE AND CONVENIENT NEW JERSEY AIR METERS. TECHNICAL BULLETINS AVAILABLE UPON REQUEST.

NEW JERSEY METER CO., INC.
89 Terminal Avenue • Tel. FU. 1-3037
CLARK, NEW JERSEY



POSITIVE ACTION
PLENTY OF BRAWN

Sturdy, compact Wood's Timing Belt Drives offer outstanding solutions to a wide variety of drive problems. They provide instantaneous, slip-free response; require no lubrication, no take-up devices . . . eliminate belt matching. Speed range, 0 to 16,000 fpm. Load capacity, up to 600 hp and above. Look into the many other cost-saving advantages, plus Wood's "5 Simple Steps" to Timing Drive Selection. Write for BULLETIN 21103.

T. B. WOOD'S SONS COMPANY
CHAMBERSBURG, PENNSYLVANIA
ATLANTA • CAMBRIDGE • CHICAGO • CLEVELAND • DALLAS

TDF/61

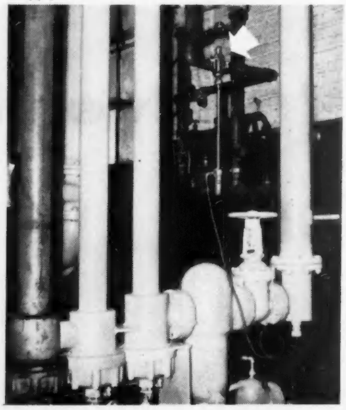
Compressors can work to capacity

FACTS: The Sarco T-44 Cooling Control automatically controls water temperature for compressor cooling . . . with minimum water consumption . . . regardless of load variation, changes in pressure, or water supply temperature.

FACTS: The Sarco T-44 is self-powered, gadget-free, simple, fully modulating. It's packless, no stuffing box, no leaks, no valve stem jamming. Self contained with no part of mechanism exposed. Thousands are providing dependable, inexpensive service.

HOW REVERE PLANTS TOOK ADVANTAGE OF SARCO T-44: In a number of their plants, Revere Copper and Brass, Incorporated had compressor problems: wasted water, sweating cylinders, interference with proper lubrication, and unreliable manual control of water supply. With the installation of Sarco T-44's, great quantities of water are now being saved. Tool and compressor maintenance has been greatly reduced and errors inherent in manual control have vanished.

Available in standard 50° adjustment ranges: 60-110°F.; 85-135°F.; 110-160°F.; and 135-185°F. Sizes ⅜", ½", ¾", 1".



For information on Sarco T-44 Self-Powered Cooling Controls, contact your Sarco sales representative, or sales office, or write:

6902

SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.
STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES